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THE MAGAZINE OF THE WORLDWIDE ELECTRONICS INDUSTRY

SPECIAL DOUBLE ISSUE

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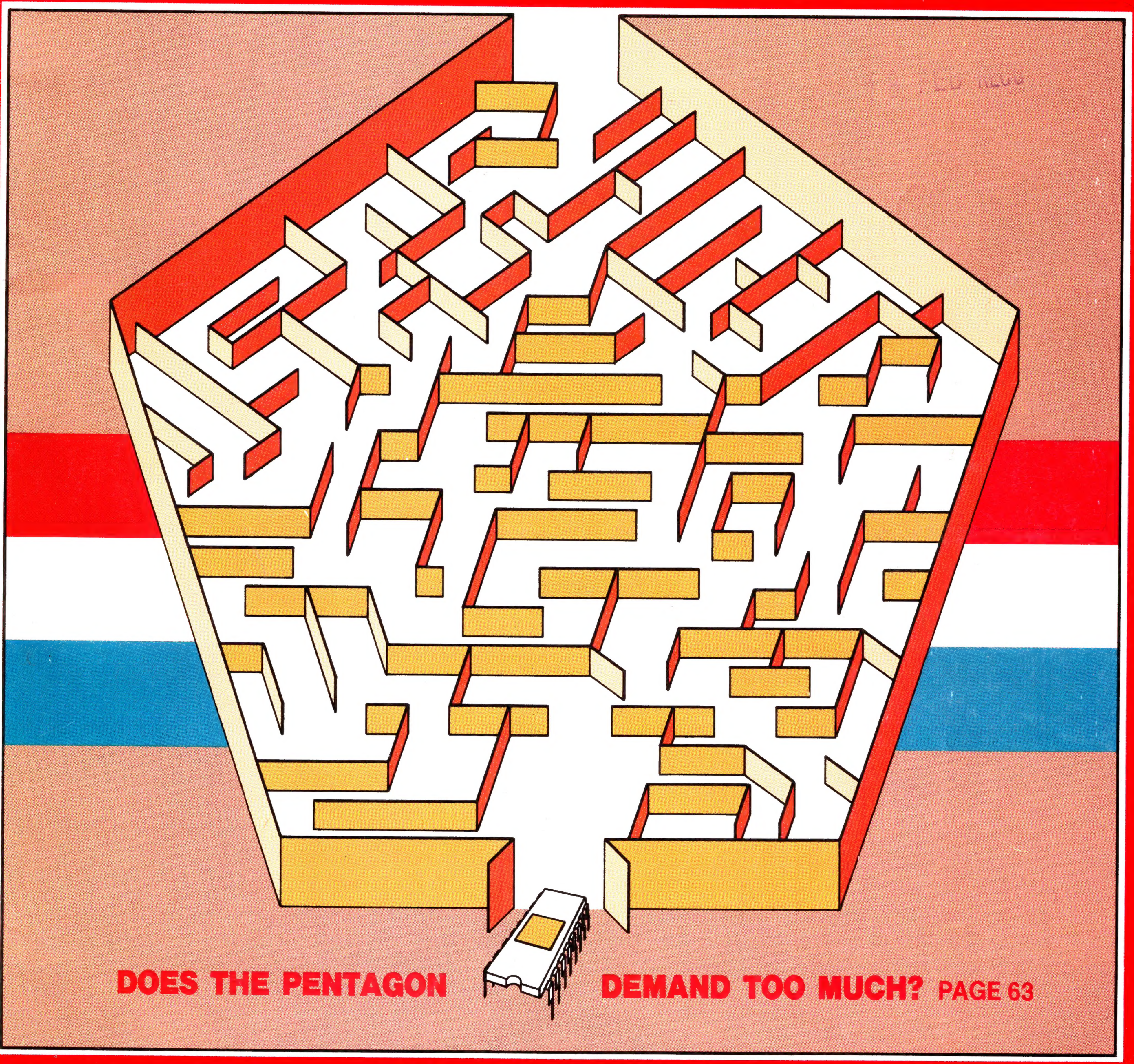

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DOES THE PENTAGON DEMAND TOO MUCH? PAGE 63

Is artificial intelligence finally coming of age?/ 51

Semiconductor startup takes advantage of slump in the market/42

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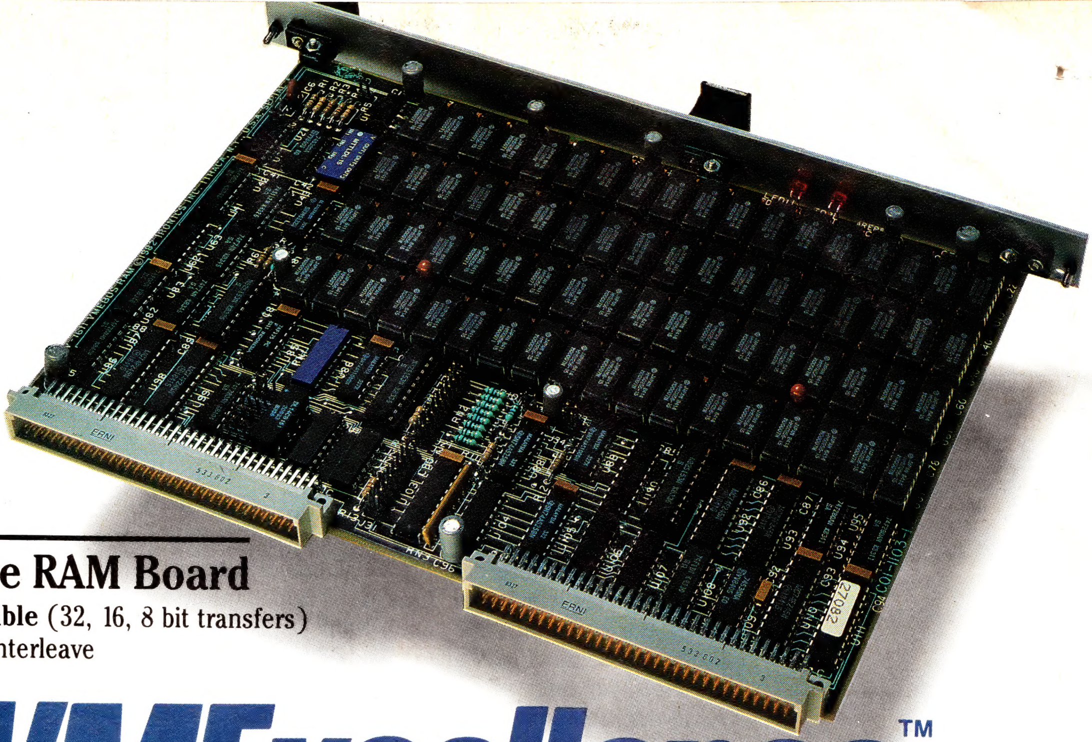

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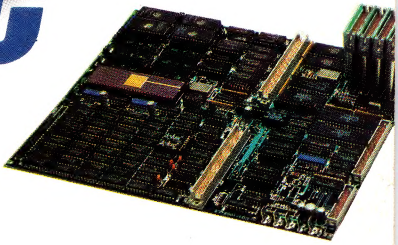

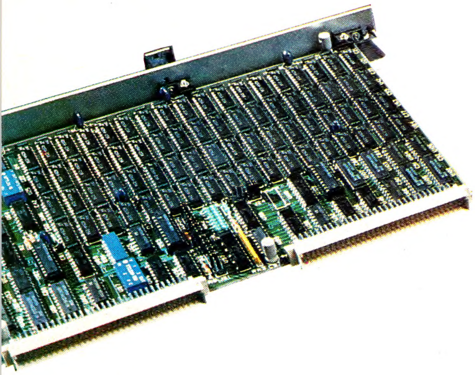

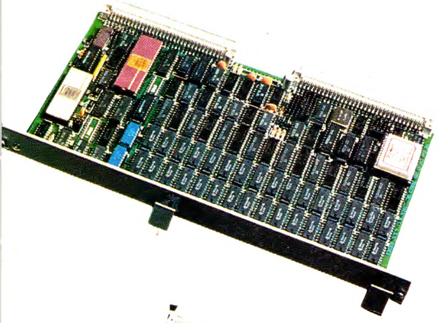

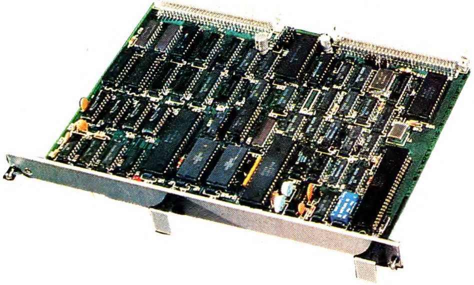

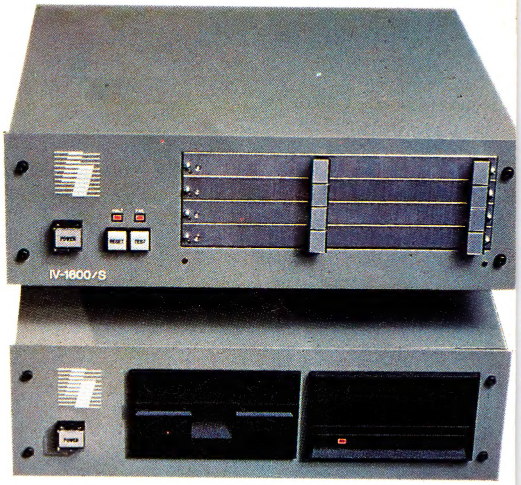

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Next ElectronicsWeek

Listening in at the ISSCC

In large memory chips, manufacturers are working their way through the transition to submicron geometries. So it stands to reason that at the International Solid State Circuits Conference—one of the most important meetings on the semiconductor industry's calendar—memories are receiving the bulk of the attention. However, what is surprising is their domination of the program: memories are the subject of 30 papers, almost a third of the total, with 10 papers focusing on 1-Mb dynamic random-access memories. For an in-depth report on what this year's ISSCC—to be held Feb. 13-15 in New York—will be like, see next week's *ElectronicsWeek.*

Lending persistence to digital scopes

Variable persistence has been around a long time in analog oscilloscopes—since 1966, to be exact. In that time, it has permitted users to control how long waveforms remain on screen. In such analog storage scopes, variable persistence is a handy tool for capturing single-shot and low-repetition-rate signals. But it becomes even more valuable when implemented in a digital scope, where it permits persistence time to be set precisely, makes the picture easy to adjust, and keeps the display from fading or blooming. For a full exploration of all the benefits that can be derived from variable persistence, see the article in the next issue of *ElectronicsWeek.*

ElectronicsWeek index available

An index of the editorial material that *Electronics* and *ElectronicsWeek* ran during 1984 (Vol. 57) will soon be available. To get your copy, just circle No. 475 on the reader service card. If you no longer have the card, order the index by letter from Kathleen Morgan, *ElectronicsWeek,* 1221 Avenue of the Americas, New York, N.Y. 10020. The 1984 index is free of charge; those for earlier years may be ordered from our reprint department for $4 each.

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ElectronicsWeek

THE VOICE OF THE INDUSTRY, HEARD EVERY MONDAY

EXCLUSIVE COVERAGE

Special section details military IC problems/63

Technology Around the World

Integrated Circuits DOE report raps Sandia's expansion plans. The Department of Energy's inspector general denounces Sandia's ambitious plans to start a rad-hard-IC production plant in Albuquerque **15**

Research & Development Europe's Esprit finally sets sail. At long last, the European Community has its strategic program for R&D in information technology in place. The U.S. and Japan are targets **17**

Computers Unix continues to experience growing pains in the market **19**

Semicustom Circuits Laser speeds gate-array hookup. A new process could produce custom ICs in lots of 20 or less in about three weeks **21**

Optoelectronics Optical recording looks to a new frontier. Erasable optical disks are a promising optoelectronic venture **24**

Software Carnegie-Mellon starts a DOD software center. The $103 million Software Engineering Institute has begun hiring **27**

Business Investment shifts in artificial intelligence. Venture capitalists are leaving the AI scene, creating a void that the business community seems willing to fill **28**

Television Digital TV set can be aligned remotely **30**

Military Procurement Salvos fired in war on waste. The military is under attack from several quarters in an effort to end waste in procurement **32**

People Willis J. Whitfield, clean-room inventor, takes role in stride. Donald W. Brooks aims to return Fairchild to its glory **38**

Companies Semiconductor startup braves industry recession **42**

(continued on p. 6)

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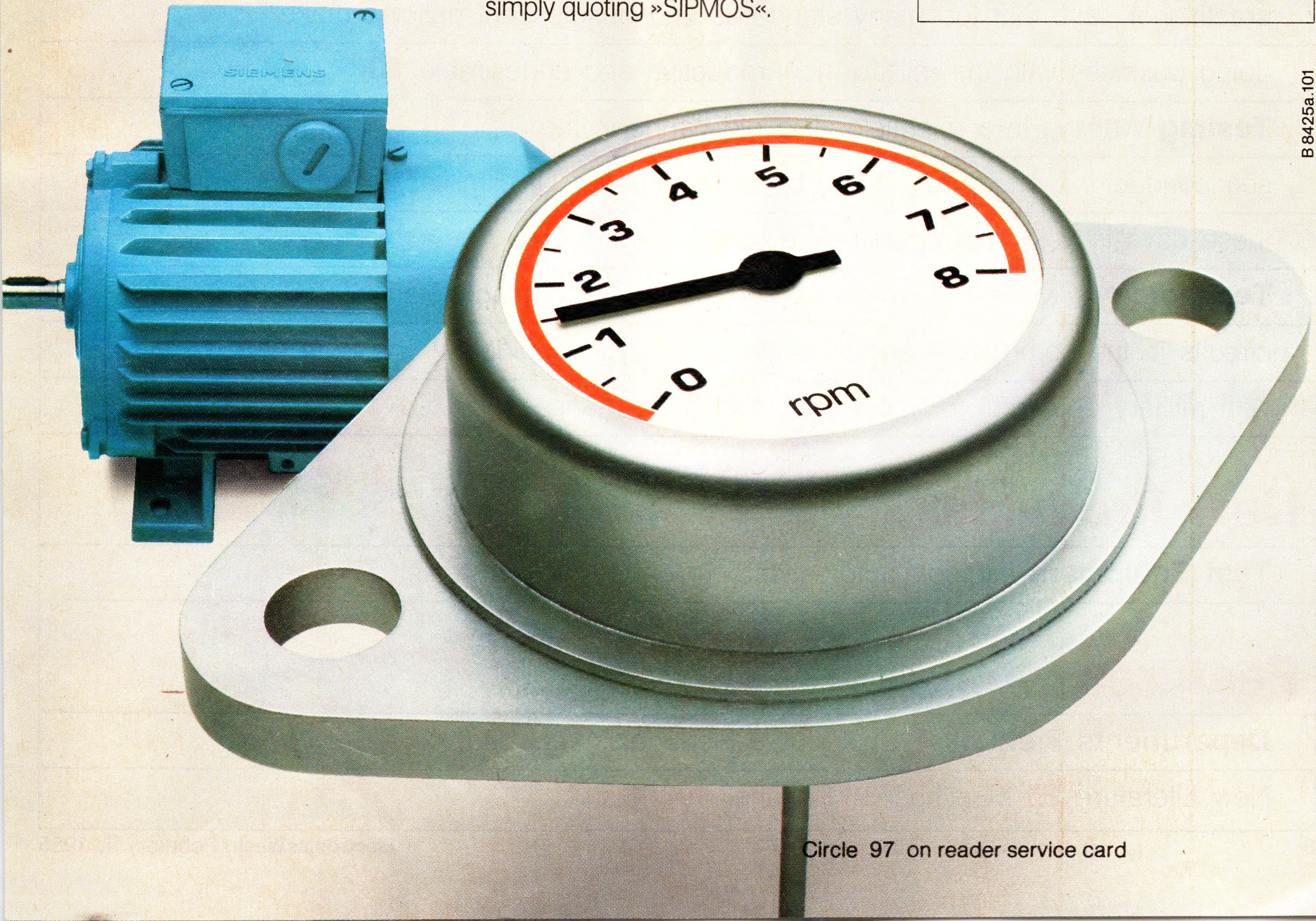

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VOLUME 58, NO. 5 FEBRUARY 4, 1985

ElectronicsWeek

Special Technology Reports

Chip Repair Lasers repair dynamic RAMs. Redundancy and laser repairs are becoming indispensable tools for meeting the booming worldwide demand for 256-K DRAMs **45**

Artificial Intelligence Has AI's time come at last? Though today's AI technology cannot do all the things that overenthusiastic supporters claim it can, the technology's commercial aspects look stronger than ever. But the financial payoffs are slow in coming **51**

Special Section: The IC-Military War

Procurement DOD's buying policies vex IC makers. One industry practitioner says that too many standards and obsolescent policies make doing business with the military nonproductive and undesirable **63**

Testing Walking in a minefield. The old hands in the semiconductor industry say doing business with the U.S. military these days is risky and potentially disastrous **69**

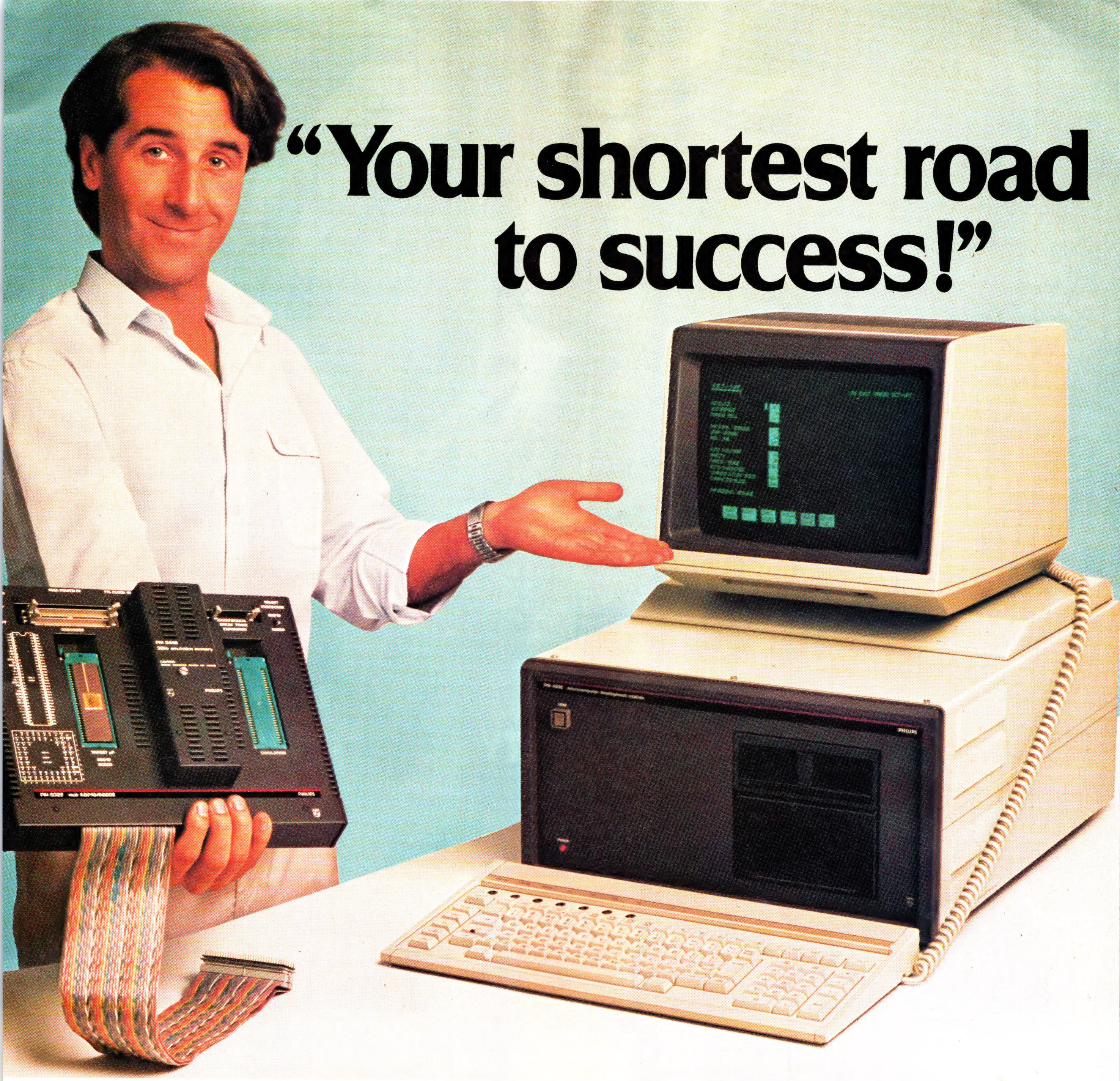
Technology Civilian ICs wear military garb. The wider acceptance of CMOS circuits in the commercial sector is encouraging to engineers who deal with military demands for full-temperature performance **72**

New Products

Test Equipment Intersort automatically unloads ICs from tester **77**

Features

Departments Previews **2** Up Front **9** ElectronicsWeek Index **34** New Literature **95** Meetings **96** Editorial **100**



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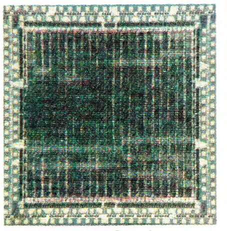

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CONGRESS: HIGH-TECH NEEDS NO HELP

First the good news: members of Congress think the high-tech industry—including electronics—is the fastest-growing industry in the U.S. and among the country's most important. Now, depending on economic beliefs, the bad news: members of Congress don't think the high-tech industry needs any help from the government to prosper. These are among the results of a survey that Touche Ross & Co., an accounting and consulting firm, undertook to gather congressional views on issues that involve the small-business community. (Although executives of Touche Ross were reluctant to define small business, they finally agreed upon those firms with 50 or fewer employees or those firms that have revenues of less than $50 million a year.)

Congressmen rated high technology as the second most important business area (behind manufacturing in general) for the country's overall economic well-being, according to the Touche Ross survey. The respondents also voted high technology the industry that will show the highest rate of growth between 1984 and 1986. Still, when it came to voting on which U.S. industry area involving small businesses should be protected from certain forms of foreign competition, high technology received an 11% rating, behind clothing manufacturing (31%), automotive products (26%), and metalworking (15%). The highest proportion of respondents (29%) represent the West. Next came the Midwest (26%), the South (20%), the East (16%), and the North (9%).

"We can't really account for the discrepancy" between Congress's belief that high tech is so important but that it doesn't need protection from competition, says Joel Koenig, national director of Touche Ross's Enterprise Group, which conducted the survey. The perception among Congressmen, he continues, is that "high technology can effectively compete with foreign competition." Adds Robert Kelly, who analyzed the survey's results at Touche Ross, "The feeling is that high tech is competitive and aggressive and doesn't need protection. Usually you protect industries that aren't doing well and right now [high tech] is doing quite well." Koenig thinks the industry has an awareness problem with leaders in Washington. "They think we're far ahead of foreign competition [in high technology]. Congress is behind the times. It needs to have more information regarding high technology." Herbert C. Speiser, a Touche Ross executive who works with high-tech firms, claims the industry's problem is that it has "not banded together in a lobbying group." The efforts that small, high-tech businesses have supported have been mostly efforts spearheaded by large corporations, such as IBM Corp. or Apple Computer Inc., Speiser says. "Protectionism is not a concern yet. As more foreign companies move into the U.S., that will drive the move to protectionism. One day Congress will wake up and say it has to help high technology."

On the other hand, the American Electronics Association's vice president for government operations, Kenneth C.O. Hagerty, is pleased with the findings. "They suggest Touche Ross is hearing from authentic high-technology people" and not from those who are merely captivated by high tech's cachet. "We don't think industries or companies are made more productive by being protected," he says. "You don't need protection to succeed. Authentic high-tech companies believe they can succeed" when dealing with open competition. ☐

TI, National to match performance of advanced bipolar chips . . .

With advanced bipolar circuits still breaking speed-performance barriers, chip makers are finding a greater need to closely match operational characteristics of products with competing alternatives. A difference of even a nanosecond can throw off a system design when one circuit is substituted for a similar high-performance chip. To cope with this situation, Texas Instruments Inc. is teaming up with National Semiconductor Corp. to more closely coordinate chip performance over a long line of advanced bipolar integrated circuits. TI also will second-source National's new programmable logic array chips, to be made from 2-micron emitter-coupled logic technology. National will introduce its ECL arrays later this year. In exchange, it will second-source TI's six-month-old field PLAs. The bipolar design-exchange deal, disclosed last week, covers field-programmable logic, memories, and large-scale integrated components. The agreement calls for cooperative product development. The two firms will exchange technical data on processes, characterization, and tooling. However, each will continue producing advanced bipolar chips with its own proprietary processes. TI's process is called Impact, National's Oxiss. ☐

. . . as Intel signs up Korean firm in a second-source deal

Intel Corp. founder and vice chairman Robert N. Noyce helped negotiate the agreement disclosed last month under which Korea's giant Samsung Semiconductor and Telecommunications Co. will make and market Intel chips in the Far East. The deal reportedly is part of Intel's strategy to establish its architecture as a Pacific Basin standard. Samsung will start making some Intel microcontrollers, microprocessors, and peripheral chips this year in its Korean facilities. Neither firm would identify which circuits are covered by the deal. Intel last month also said that Japan's Toshiba Corp. will second-source its Multibus II ICs and market them worldwide. ☐

Major video-tape makers to go after 8-mm video market in Japan

TDK, Hitachi Maxell, and Fuji Photo Film will follow the lead of Sony Corp., which started selling 8-mm camera-recorders and video tape last month in Japan. (Sony also started selling 8-mm video tape in the U.S. market then.) TDK Corp. plans to start selling 8-mm video tape in the domestic market later this month and will export the products to the U.S. in March. Hitachi Maxell Ltd. and Fuji Photo Film Co. will start sales in the domestic market in March and April, respectively. Hitachi Maxell will begin selling in the U.S. soon after it enters the Japanese market, but Fuji Photo is still uncertain when it will begin exports. Camcorder users will have a choice of tape with recording times of 30, 60, and 90 minutes, with 120 minutes to be added soon. ☐

NTT rules out buying U.S.-made satellites

The hopes of U.S. satellite manufacturers for doing business with Japan's Nippon Telegraph & Telephone Public Corp. (NTT) have been checked even before NTT becomes a private corporation in April. NTT president Hisashi Shinto says, "We have no plans to purchase American satellites, because we have spent more than $314 million to develop our own satellites [code-named CS2 and CS3]." NTT purchased about $137 million worth of U.S. telecommunications products in the fiscal year ending last March, and the current fiscal year's total is expected to drop to about $126 million. ☐

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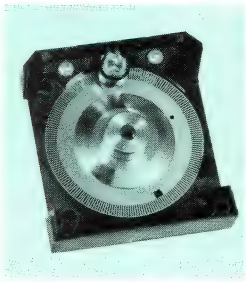

Complimentary Data Sheets are available that tell the whole story. Drop us a line or call and speak with one of our application engineers.

Illustrated is the CP-200-XXX Incremental Integrated Encoder/Tachometer (Data Sheet #120)

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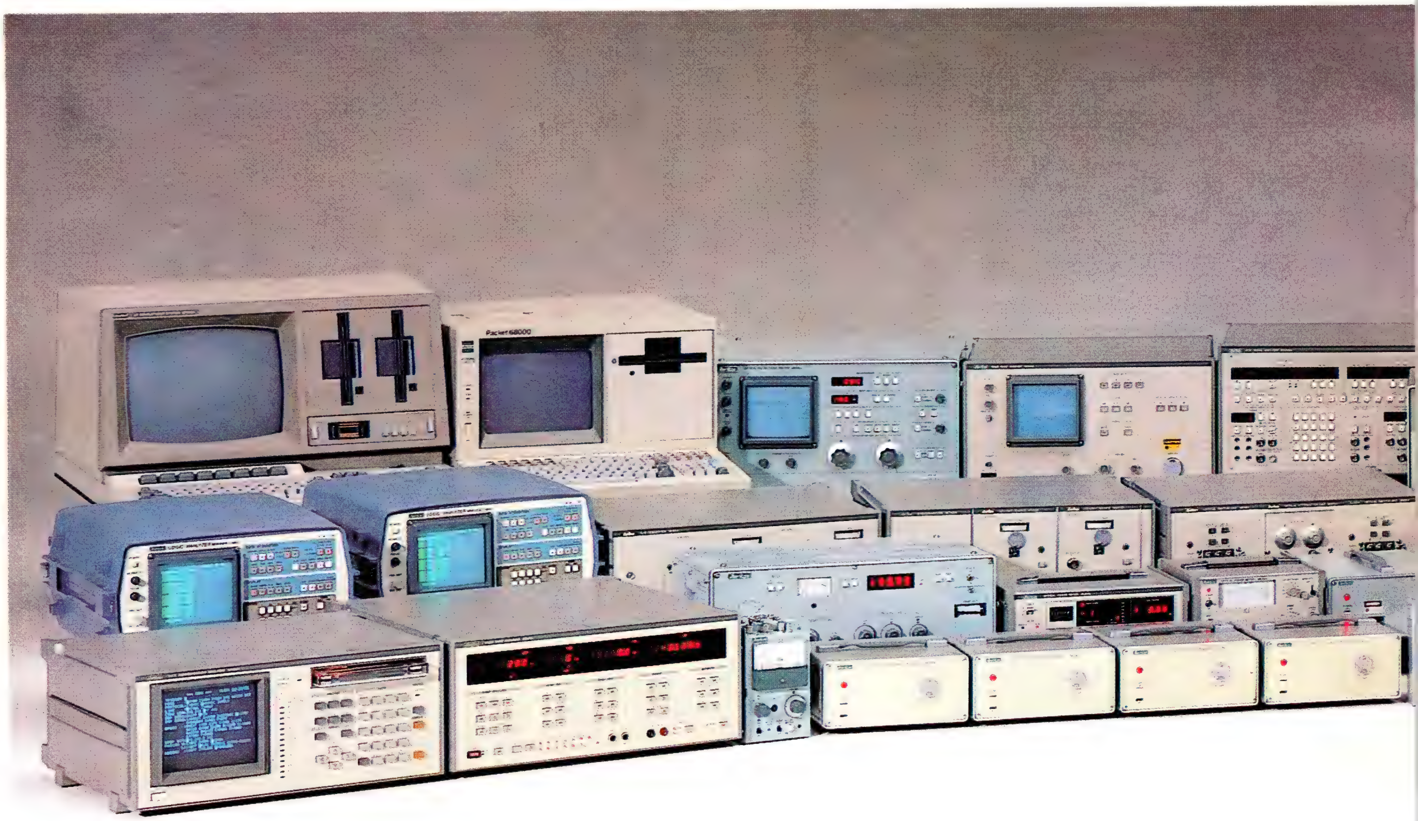

The "Personal-Sized" MS610A Spectrum Analyzer

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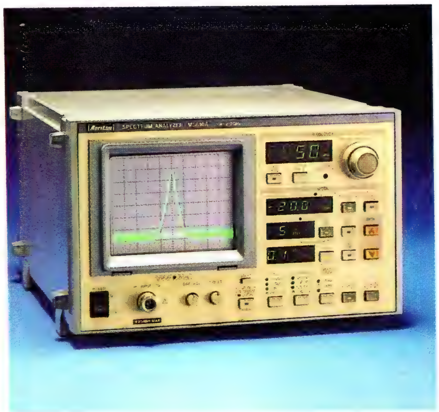

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AROUND THE WORLD

WATCHDOG RAPS SANDIA

Inspector general's report denounces proposal to spend $200 million for a facility to manufacture radiation-hardened ICs

☐ *by Larry Waller*

Albuquerque, N.M.

Long a leader in radiation-hardened technology, Sandia National Laboratories has run into hard going in its effort to go into production of sub-micron rad-hard integrated circuits.

The nonprofit outfit, a main contractor to the Department of Energy, plans a $200 million expansion to upgrade the IC fabrication facilities at its Center for Radiation-hardened Microelectronics so that the center can handle submicron chips. But the DOE's inspector general has denounced the plan.

Also opposed to it is the Electronic Industries Association, which is wary of the commercial impact of Sandia's expanded role. And though semiconductor makers give Sandia high marks for its technology (see "Filling a gap in semiconductor research," p. 16), some are lukewarm on the idea of a government-backed competitor even in the low-volume niche of rad-hard ICs.

Sandia's major roadblock, though, is the DOE's Office of the Inspector General. It has stalled Sandia's proposed addition of a Radiation-hardened IC Facility, originally scheduled to be started this spring. The cost is budgeted at some $20 million this fiscal year, another $20 million next year, with more to come in later years.

The inspector general's report, "The Planned Expansion of Microelectronics Capability at Sandia National Laboratory," goes far beyond denouncing the plan. Prepared during mid-1984, shown to Sandia officials late in the year, and published Dec. 14, the 41-page document not only shoots down the proposed facility but challenges the way Sandia runs the center and questions whether such an operation makes sense in its present form.

Officials at Sandia and the DOE are amazed by the report. They point out that the DOE was consulted during the planning and gave the required approvals. What's more, Congress has appropriated the first funds for the facility.

Keep it clean. For its current radiation-hardening work, Sandia stores and processes wafers in a class 100 laminar-flow clean room. During processing, computer control is used as much as possible.

But what baffles Sandia officials most is the report's bedrock assumption: that a strong private-sector capability in rad-hard microelectronics has appeared, which the proposed advanced work at Sandia would wastefully duplicate. In fact, the introduction, signed by Inspector General James R. Richards, advises Sandia's main customer, the DOE's assistant secretary for defense programs, "to make better use of private industry capabilities."

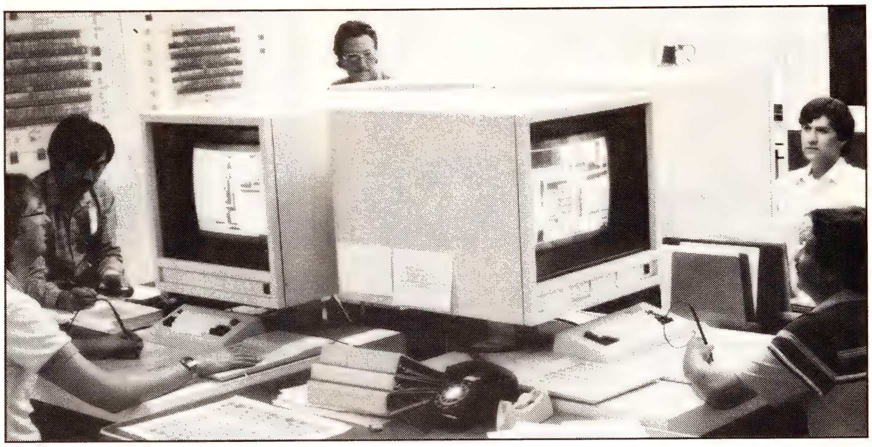
Difficulties. This suggestion nettles Sandia's microelectronics management. The view that semiconductor firms are champing at the bit to take over Sandia's role simply does not jibe with experience, explains B.L. Gregory, director of microelectronics. "This is a difficult technological area for him [the inspector general] to understand."

Sandia's charter in hardened chips has been consistent from the beginning, according to Gregory. First, it creates the technology—from processes to chip design—and builds laboratory prototypes. From that point, the baton is passed to industry for production of hardened parts. When no company can be found to produce a low-volume part that is needed for an important military program, Sandia becomes the supplier of last resort.

In fact, Gregory insists, "We only produce when we have to." He points to a record of more than a dozen cooperative programs with industry firms since 1980, many that continue now. The most recent program, with Harris Corp.'s Custom Integrated Circuit Division, is a prime example of how well such cooperation can work, according to Gregory.

When Sandia needed a hardened version of an 8-bit CMOS microprocessor, it went to Intel Corp. and bought the design of the three-chip model 8085. After it was reworked to rad-hard requirements, the manufacturing rights reverted to Intel, which passed. Sandia offered it to Harris, which now markets a number of the chip types.

Industry support. Sandia's performance generally earns kudos from semiconductor industry executives, a source of support that could help if troubles grow. At Harris, Robert Quinn, vice president of development and planning, counts himself solidly behind Sandia. "We feel they have contributed a great deal in rad-hard research and development."



Reworked. Converting a conventional chip to a radiation-hardened version calls for a new layout, which Sandia engineers accomplish using an extensive computer-aided-design setup.

Sharing this view is T.S. "Stony" Edwards, vice president of National Semiconductor Corp.'s Military/Aerospace Products Group. "Clearly, there's a need for that [Sandia] effort, because of the specialized nature of superhard product." He notes, however, that a larger market involving tactical weapon systems seems to be opening, which could attract more companies.

RCA Corp. is another firm that affirms Sandia's rad-hard engineering prowess. But RCA, which sides with the inspector general's report against building the new facility, has its own caveat. States Lucien DeBacker, the Solid State Division's manager of marketing for government high-reliability ICs, "It [Sandia] has a narrow technological focus not indicative of the industry."

More than anything else, the comment refers to Sandia's lack of enthusiasm for RCA's pet approach to radiation hardness—silicon-on-sapphire technology. Such candid comments were given to investigators preparing the report, along with compliments on Sandia's technology, according to the RCA marketeer.

Also on record as against the proposed expansion is the EIA, which is concerned about the possible use of the proposed facility to compete against private firms, as the report warns. The EIA's position, stated in a letter to the Secretary of Energy, results from a survey conducted among its members, says Jean Caffiaux, senior vice president of the Government Division.

DOE rebuttal. Until the problems raised by the report are resolved, the project is stalled. The DOE Office for Defense Programs expects to come up with its rebuttal around March 1. Afterward, all parties will sit down and negotiate. William Roberts, deputy executive director of the inspector general's office, claims he knows of no case where the inspector general's recommendations have been overruled.

Nonetheless, few industry insiders expect the Sandia Center for Radiation-hardened Microelectronics to be effectively dismantled along the lines of the inspector general's report. As for the submicron production facilities, some sort of compromise seems likely. But there is always the danger the center may become a victim of the administration's drive to slash the DOE budget. ☐

Filling a gap in semiconductor research

No counterpart exists for Sandia National Laboratories' Center for Radiation-hardened Microelectronics, either in industry or in government. It was formed in 1973 at the Albuquerque, N.M., complex to fill a void in semiconductor research. Weapons-systems designers working at Sandia found they needed advanced MOS chips that could resist the degrading effects of ionizing radiation and bipolar parts that would work despite fast neutron exposure. Because industry had no interest in making these components, the laboratory set up an in-house production source.

Though the center supports a number of technologies, it deals primarily with metal- and silicon-gate CMOS. Feature sizes have steadily shrunk from 7-μm lines to the present 2-μm technology used in CMOS III. The next advance, CMOS IV, uses 1.25-μm rules that could place up to 2 million transistors on a chip—20 times the 2-μm level.

The problem is that the center's present facilities cannot handle work on the submicron level—thus creating the need for the new radiation-hardened IC facility, according to Sandia. Present production work has been contracted out to Bendix Corp., which does it at the Sandia facility.

The center employs about 220 people and received $25 million in funding from the Department of Energy in fiscal 1984. Non-DOE funds, mainly from the Department of Defense, came to about $22 million, with $14 million for research and development and $8 million for chip fabrication. The center has about 400 wafer starts a month, which is a low production level, even by the standards of the commercial semicustom-chips business. –L.W.

EUROPE'S ESPRIT FINALLY SETS SAIL

The EC's planned push to save its data-processing industry from foreign competition freezes out non-Europeans

□ *by Robert T. Gallagher*

Brussels

Well behind schedule as a result of prolonged political and budgetary bickering, the Commission of the European Communities has gotten its European Strategic Programme for Research and Development in Information Technology (Esprit) program off the ground. Last week the Commission announced the funding of more than 100 research projects that involve close to 300 different companies, universities, and research institutes of EC member countries.

The objective of Esprit is to stimulate cooperation in precompetitive research to give the native European data-processing industry a leg up in its battle to fend off ever-intensifying competition from its U.S. and Japanese counterparts. One measure of just how seriously the EC is hewing to this objective is the extent to which foreign firms with European-based subsidiaries engaged in R&D were admitted to the club. Although technically qualified for participation in Esprit, those firms were all but shut out.

Big Blue's blues. Particularly striking is the case of IBM Corp. Although IBM had fallen afoul of the EC and was forced to settle an unfair-trade-practices suit with the EC out of court [*ElectronicsWeek,* Aug. 13, 1984, p. 20], EC officials at the time had affirmed the U.S. giant's right to participate in the program. In the announcement of awards, however, only the name of IBM's West German subsidiary showed up on the list.

What's more, IBM Germany will be contributing to only two projects, both of which are in computer-integrated manufacturing, perhaps the least strategic section of Esprit. One of those projects brings together no fewer than 15 other partners.

The EC's official reason for IBM's having been virtually shut out of Esprit is that accepted projects were limited to those proposed by at least two different partners from two different EC member countries. Most of the U.S. company's proposals did not meet that condition. An EC official admits that IBM was simply unable to find partners because European manufacturers of data-processing equipment were loath to further the objectives of the industry's dominant competitive force.

Something extra. For Michel Carpentier, Esprit will have succeeded if it creates an atmosphere of synergy among European firms.

Indeed, a top executive at one of Europe's principal computer houses scoffs at the idea that cooperating with IBM should be considered seriously. "Sure, IBM approached us to discuss participation in Esprit, but there was never any real chance that the major European manufacturers would cooperate with them," he explains. "All of us are fighting for survival, and in some cases survival depends on grabbing a chunk of IBM's business. If you were to say that there was a general conspiracy to keep IBM out of Esprit, you would be going too far. But not all that much too far."

No tears are shed. At the EC itself, there was little remorse for IBM's minimal presence in the program. "When you come right down to it, Esprit is a program that's run in the interest of the EC member countries," points out one EC official. "It would be difficult to argue that those members' interests would be served by having European taxpayers subsidize IBM's precompetitive research."

What those European taxpayers will be subsidizing are 104 projects that were received in response to the EC's 1984 call for proposals. They all fall into one of five areas: advanced microelectronics, software technology, advanced information processing, office systems, and computer-integrated manufacturing. Total funding for the projects will be 360 million European Currency Units (ECUs), or about $260 million; half the money will be paid by the EC, and each award will be matched by the participating partners.

In the current round of awards, advanced microelectronics projects—a total of 27—received more of the funding than any of the other areas. Lagging behind, with just over half that number of projects, was software technology. EC officials consider software to be of sufficient strategic importance to have carried over funding for that area from their 1984 allotment to add to the 1985 awards. EC Esprit distributions for the 1985 awards will be some 215 million ECUs ($150 million).

Not a total solution. That translates into a $300 million total research investment. If this figure looks a bit light, Michel Carpentier, director general of the EC's Task Force for Information Technologies and Telecommunications, is quick to point out that the program is not intended as a solution to all European data-processing problems. "Esprit is not meant to try to do everything; that would be absurd," he declares. "The idea is to create an atmosphere of cooperation and synergy necessary to face the challenge of research in key areas."

The question most observers were posing when the idea of Esprit was first announced was whether or not European companies would be able to make the program work. Jens Moritz, coordinator for Esprit projects at West Germany's Siemens AG, admits that there are some project coordination difficulties, in addition to the language barriers and the differences in corporate cultures and strategic goals.

To back up a general, though tempered, feeling of optimism toward Esprit, most European industry executives point to an EC pilot research program that most of them deem successful. "There was a large degree of skepticism that Europe could ever learn to cooperate," points out Mike Watson, technical director of International Computers Ltd. "But this very success has meant that we must now focus attention on what has to be done.

"Esprit alone is not enough," he goes on, explaining that "Esprit is aimed at precompetitive research. The product-development phase is not permitted under Esprit and that costs us 10 to 20 times more than the research phase." ☐

A SELECTED LIST OF ESPRIT PROJECTS

Project	Participants	Country
Advanced Microelectronics		
Silicon-on-insulator materials and processing toward three-dimensional integration	Thomson-CSF CNET GEC LETI University of Cambridge University College, Cork	France France UK France UK Ireland
Submicron bipolar technology	Thomson-CSF AEG-Telefunken The Plessey Co.	France Germany UK
Description language for VLSI	Philips Siemens	The Netherlands West Germany
Integrated optoelectronic circuits for very high bit-rate optical-fiber transmission systems	CSELT AEG-Telefunken British Telecom CNET GEC Heinrich Hertz CGE-Marcoussis SEL (ITT) STC Thomson-CSF	Italy West Germany UK France UK Germany France West Germany UK France
Software Technology		
Software production and maintenance management support	Siemens Cerci CIT-Alcatel Philips STC Data Management	West Germany France France The Netherlands UK Italy
A basis for a portable common-tool environment	Bull GEC ICL Nixdorf Olivetti Siemens	France UK UK West Germany Italy West Germany
Advanced Information Processing		
Communication failure in dialog — techniques for detection and repair	Educational Research Center ITT Europe Linguistics Institute Memory Computer University of Leeds University of Pisa	Ireland UK Ireland Ireland UK Italy
Advanced algorithms and architectures for signal processing	CSELT AEG-Telefunken GEC The Plessey Co. Thomson-CSF	Italy West Germany UK UK France
Computer-Integrated Manufacturing		
Control systems for CIM/CAM Solution	Comau Digital Equipment Renault	Italy West Germany France
Development of a flexible automated-assembly cell and associated human-factors study	Westland Helicopters Dantec Elektronik Riso National Laboratory University of Sheffield Vrije University	UK Denmark Denmark UK Belgium

SOURCE: COMMISSION OF THE EUROPEAN COMMUNITIES

UNIX HAS GROWING PAINS

Dallas

The emerging but still uncertain world of AT&T Co.'s Unix operating system and the long line of Unix derivatives converged at a most appropriate site here at the UniForum '85 show.

In late January, more than 14,000 persons attended the first event held in Dallas's Infomart—itself a daring $97 million Texas-sized venture to create a trade mart for the entire computer and information-processing industry.

Aiming for change. The venue for the get-together was appropriate on more than one level. For each in its own way—multitasking Unix software and the one-stop-shopping Infomart complex—is aimed at changing how customers view new computer systems. Both, however, are less than sure bets to become industrywide hits.

Attendees left the conference with no new clues to IBM Corp.'s secretive strategy to compete against Unix. Most observers fear that IBM plans to keep the Unix market in check by fostering that kind of confusion.

For Unix merchants to succeed, however, they must woo large corporate sales. That effort hinges on their ability to shape the pervasive and highly popular programming environment into a compatible new class of powerful operating systems for next-generation office software and data-processing applications.

According to many industry observers at UniForum, Unix suppliers first must have a battery of unique portable application packages that run circles around single-user software for personal computers. Or they must have well-entrenched proprietary software for mainframes. But to get these application packages, standards in the Unix operating system must be more finely focused.

Still, this year's UniForum was filled with optimism along with plenty of hardware and software vendors. Exhibitors continue to chase what some estimates say is a $5 billion-a-year Unix market, growing at nearly 25% a year. But if Unix remains only a technical-engineering market, most analysts agree few of the exhibitors will survive the next 18 months.

The exhibit area this year, however, covered the widest possible range of processing power—from low-end personal computers to the first 64-bit supercomputer, from Convex Computer Corp., ever to operate on a show floor [*ElectronicsWeek,* Oct. 29, 1984, p. 17]. Interface programs for Unix users, application data-base integration packages, and hardware and software products that enable Unix to run on the popular IBM Personal Computer also populated the UniForum floor.

Captivating. Infomart, a $97 million venture in Dallas to create a high-tech trade mart, was the site of UniForum '85. The center contains some 1.5 million ft² of space in an eight-story reproduction of England's Crystal Palace.

Networking issues also highlighted the 1985 conference, which featured the first multivendor implementation of a new Network File System (NFS) from Sun Microsystems Inc. (see "An open file-sharing system arrives," p. 20). Sun is promoting the NFS link as one way to unite Unix suppliers and help third-party systems houses break IBM's grip on key personal computer office markets.

AT&T's highly promoted System V clearly continued to gather widespread support from Unix vendors in most major camps, including many who still prefer the University of California at Berkeley's 4.2 version, which contains powerful networking enhancements. Although many users will not convert their operating systems to System V, leading supporters of 4.2 are now promising to make their software compatible with AT&T's preferred Unix.

At the opening of the show, Microsoft Corp., champion of the MS-DOS operating system for IBM PCs and PC-look-alikes, tossed the weight of its Xenix implementation of Unix III behind System V. Microsoft reaffirmed its plans to extend Xenix to full compatibility with System V. In return, AT&T announced that it will offer Xenix System V in its 6300 line of personal computers.

The telecommunications giant also has chosen Microsoft to participate in a System V verification test for software being developed by AT&T with assistance from Unisoft Systems, of Berkeley. The test program will help independent computer manufacturers determine whether variations of Unix comply with AT&T's System V interface definitions, which were also released at UniForum.

In addition, AT&T continued to close deals with the leading microprocessor manufacturers. The firm announced further developments for the 68000 family with Motorola Inc. as well as implementation of a System V port on National Semiconductor Corp.'s 32000 line. A System V port is ready for Intel Corp.'s iAPX286 16-bit chip, according to AT&T. To be available by the end of April, the Unix System V/286 source code may be licensed from AT&T for $43,000 for the initial 286 host system and $16,000 for each additional host.

Pivotal. Microsoft Corp., which developed the MS-DOS operating system for IBM Corp. Personal Computers, threw the weight of its Xenix implementation of Unix III behind AT&T's System V.

Intel's George Alexy, product marketing manager for high-end processors, believes the integration of on-chip performance features and the memory management unit will boost Unix's ability to compete in competitive office retail software markets. Alexy says the 80286's on-chip memory unit helps ensure a common implementation of Unix kernels across a wide line of systems, compared with other chip sets that can use a variety of memory management schemes.

"We all know the fantasy of Unix—that you can put it on 15 different machines, and in theory, it will be transportable software," warned John Kiefer during a panel discussion on market trends at the show. The vice president of research at Yates Ventures Inc. estimates that 27 different versions of Unix are on the market today. "Some of them play. Some of them don't," he added. Standards might make code conversion of Unix application programs easier to adapt to a wide variety of machines, but Kiefer believes that today's office user views operating-system standards differently after he has been exposed to the standards for CP/M and MS-DOS.

Kiefer says the market for Unix-based software products will reach $32 million in 1989. He also predicts the number of suppliers of Unix-based hardware will drop dramatically in the next year and a half as AT&T, IBM, and other large computer manufacturers begin to exert their marketing muscle.

At UniForum, more than 100 hardware suppliers eagerly exhibited their wares. Kiefer was less jubilant. "I'm going to make a bold projection. In 18 months, there will be less than 35."

–J. Robert Lineback

An open file-sharing system arrives

Combining the best of dedicated and time-sharing computer systems has been one of the goals of the vendors of networked personal work stations. The work stations, based on powerful microprocessors, provide the response and performance advantages of dedicated computers. The network provides the file- and information-sharing abilities of time-shared systems.

Common access to a hierarchical file system, though transparent to the user and to programs, has been around for a while in proprietary systems, such as the Domain system from Apollo Computer Corp., DECnet from Digital Equipment Corp., and the Arcnet system from Datapoint Corp. But it has been unavailable in networks that include equipment from different vendors.

At UniForum, one of the most popular exhibits was the demonstration of the Network File System, an open-system version of transparent distributed files from Sun Microsystems Inc. The firm hopes to establish the NFS as a standard for Unix networks.

Joining Sun in the UniForum demonstration were two companies that adopted the technology in the early going—Gould Inc. and Pyramid Technology Inc. During the exhibition, files were shared among Sun work stations, the Pyramid 90X line of superminicomputers, and Gould's Unix-based systems. File sharing among a Sun work station, DEC VAX system, and an IBM Corp. Personal Computer was also demonstrated at the Sun booth.

In a proprietary system such as Apollo's combined architecture and networking system, Domain, the global virtual memory is an integral part of the operating system and works well for all Apollo work stations within an Apollo net. Sun's NFS networking facility for connecting processes and files on different machines provides a general scheme to hook up systems from different vendors.

Both operating systems and applications programs can use this open-system information network the same way. A user can gain access to the original single copy of a file from anywhere in the network without having to transfer it to his machine.

Sun's file system is not part of any operating system—it does not try to define a distributed network operating system. This feature makes it easy to promote the NFS as a standard that many manufacturers can adopt. To encourage such adoption, Sun is offering the NFS technology on easy terms to interested parties and is publishing the detailed protocol specifications.

– Tom Manuel

LASER SPEEDS GATE-ARRAY HOOKUP

Thundorf, Switzerland

Design and fabrication of custom integrated circuits in lots of fewer than 20 chips and in the optimum time of three weeks will be possible with a process offered by FXL AG, a small firm in this rural community 25 miles north of Zurich. The short turnaround time compares with the two to three months that it usually takes to design and produce a custom circuit of similar complexity, typically 800 gates.

As the name given to the process—Lasarray—shows, it is based on laser techniques. Using a precisely guided laser beam and conventional etching methods, areas of prestructured circuits on a wafer that are not essential to the finished chip are removed.

Down to two hours. With this technique, about half a million points can be interconnected on a 5-mm^2 chip. For example, processing a 4-in. wafer with 200 to 24 chips takes roughly two hours, according to Peter Wüthrich, who is in charge of the engineering department at FXL.

Starting this summer, the company will offer the Lasarray service to produce circuits for outside customers. Wüthrich believes his is the only firm making such a service available to outsiders for production runs down to 20 ICs and less, although IBM is said to have equipment for small in-house production runs.

Also starting this summer, FXL will offer the production equipment as well. The Lasarray Processing Box consists of the laser pattern generator, a complete data-processing system based on a Digital Equipment Corp. PDP-11 computer, and a silicon compiler with which customers can design their own circuits. Manufactured by a number of outside firms, the equipment can be offered for less than $2 million, Wüthrich believes.

Lasarray should prove to be a boon to makers of limited-series systems. Of all the chip designs the industry needs, relatively few are made in large quantities. For example, in Switzerland, about 4,000 new circuits are developed each year. But no more than 1% of these are made in quantities that exceed 50,000 chips, Wüthrich points out. About 80% are produced in runs of less than 500 units.

Because of the long time that it usually takes to get custom-made chips, system designers often turn to standard ICs. But this practice can add undue cost to a system and lead to expensive equipment. That is because standard chips perform many functions that a particular system may not need. As a result, the system may require unnecessarily large printed-circuit boards to accommodate the standard ICs and unnecessarily extensive external wiring.

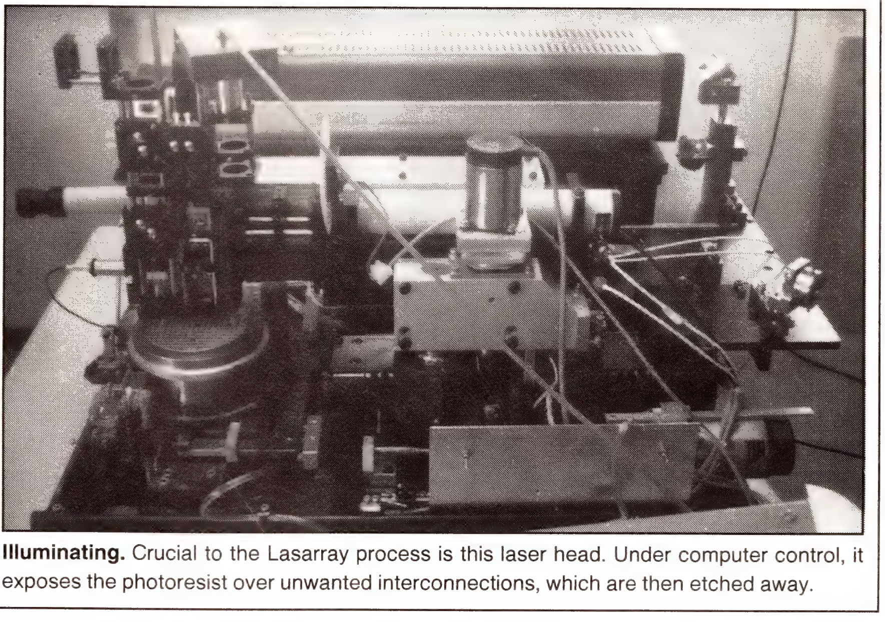
This is where Lasarray comes in. Developed jointly by six Swiss firms and institutes that formed FXL in 1982, "Lasarray should prove economical in producing circuits in lots of one to around 5,000 chips," Wüthrich declares. These quantities are usually sufficient for firms making limited-run, specialized systems.

The Lasarray process owes its fast turnaround time to the prestructured wafers and the absence of customer-specific masks. It involves a wafer with an array of logic circuits and covered with a positive photoresist. In line-by-line fashion, the wafer is moved in 1-μm steps under a laser gun that produces a beam of blue light focused to a spot diameter of 2 μm. The wafer movement occurs at a speed of about 30 cm/s.

Under computer control, the beam is turned on and off. This exposes those areas between the gates on the wafer's photoresist that are the undesired connections. The areas so treated are then simply etched away by standard etching methods. The width of the lines being exposed corresponds to the 2-μm diameter of the laser beam.

On the beam. In positioning the wafer in relation to the blue beam, a second beam—called the guidance beam—is focused on the same spot as the first. But because its light is red, it does not affect the photoresist. However, the wafer surface reflects the red light with different intensities. From the intensity variations the data needed for positioning is derived.

Besides the hardware, the Lasarray concept encompasses an extensive software program. A silicon compiler guides the engineer step-by-step through the design process—from the input of the circuit parameters to the generation of the data needed to control the laser as it



Illuminating. Crucial to the Lasarray process is this laser head. Under computer control, it exposes the photoresist over unwanted interconnections, which are then etched away.

Xebec's New Owl Redu
Storage To

Then.

Microcomputer storage history has progressed by a series of small "next logical steps." A replacement of a component here, a refinement of technology there. But now Xebec has taken a giant step, with its Owl intelligent disk file.

On the surface, the Owl might look like other 10-megabyte, 5¼" half-high Winchesters. Underneath, however, it's an example of superior technology. The integration of controller logic and drive electronics on a single board means not just one less PCB, but the elimination of expensive connectors and cabling, low power consumption (15 watts typical) and enhanced data integrity.

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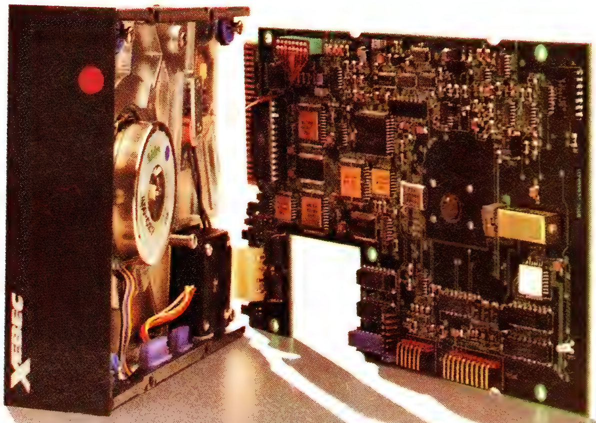

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OPTOELECTRONICS

OPTICAL RECORDING LOOKS TO NEW FRONTIER

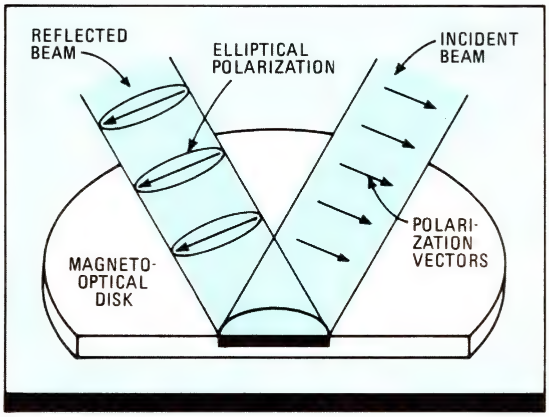
Los Angeles

There are always those who enjoy living on a frontier—ready to pull up stakes when they spot a neighbor's chimney smoke on the horizon. Electro-optical engineers fall into this category. As original-equipment manufacturers bring write-once optical disks to the market, electro-optical engineers are already blazing new trails in erasable optical disks.

The late-January meeting here of the International Society for Optical Engineering provided a peek at this new frontier. Some 1,500 people attended the week-long series of technical presentations, which included meetings on holography, high-power lasers, spectrography, and image processing. But it was the sessions dealing with erasable disks that drew the standing-room-only crowds.

"I have come just for these presentations," said Lu Yun-Wen, deputy director of the Materials Science and Engineering Research Institute at Tsingua University, in Beijing, China, echoing a familiar refrain at the conference.

Already, hardware is in sight. One of the conference chairmen, Maarten R. de Hann, who directs the Optical Peripherals Lab for Optical Storage International, in Colorado Springs, predicted that "this year will see the introduction of several write-once optical disks and the announcements of erasable optical media."



Erasable spot. Magnetic orientation of a spot heated by a laser reverses when opposite field is applied. The spot can then be read by a read beam. It can also be erased by reheating and reorienting the field to its original direction.

Indeed, one of the biggest announcements at the conference centered on magneto-optical erasable optical-disk technology. Robert P. Freese, manager of optical recording for 3M Co., claimed that 3M's 5¼-in. magneto-optic medium has a lifetime of at least eight years, which should quiet industry concerns about long-time stability of erasable optical media.

Impressed. "3M's specification is most impressive," says Edward S. Rothchild, the publisher of *Optical Memory News*. "With a data-transfer rate [50 Mb/s] that more than doubles the IBM channel rate, they are well in advance of Sony and Canon, who are working near the 12-Mb/s VAX rate. And its 12-MHz bandwidth is more than adequate for NTSC real-time video recording."

If the number of papers presented reflects what's really going on the labs, then magneto-optical technology has a big jump on its main challenger. "Phase-change recording is two to three years behind magneto-optical because the materials are not as well understood," says J.F. Olijhoek, a Philips scientist. Magneto-optical research has benefited from years of effort and millions of dollars spent in perpendicular recording research effort [*ElectronicsWeek*, Oct. 29, 1984, p. 55].

In magneto-optical recording, the active layer of the disk is uniformly magnetized in a direction perpendicular to the plane of the disk. While in that state, heating the disk with a laser until the temperature of the spot area increases by 100°C to 200°C demagnetizes the area because of the Curie effect.

After that, a magnetic coil, working with a modulated laser beam, can reverse the polarity of the magnetization in the submicron-sized spot. This effectively writes data into the disk. Because the Kerr or Faraday effect partially rotates the polarization angle of a light beam, the rotation can be detected for readout.

To erase data, the same steps are performed, except that the demagnetized spot is remagnetized with the original orientation.

Changing phases. Unlike magneto-optical recording, writing with the phase-change approach requires laser energy to induce a physical reversal between two states of a medium. It is the difference between the reflection coefficients of the two states that is read.

Fujitsu Ltd., working on all fronts in optical recording, unveiled a selenium-based phase-changing medium with some unusual properties. According to Fujitsui spokesman N. Koshino, the medium remains in a crystalline state even after deformation by the laser. Tellurium, by contrast, becomes amorphous.

The selenium indium antimony ($Se_{20}In_{35}Sb_{45}$) material bucks a research trend that has so far looked almost exclusively at tellurium alloys. Fujitsu says the medium maintains good characteristics after more than a million reversals, so it too may mark a turn in erasable optical disk research. **–Robert Rosenberg**

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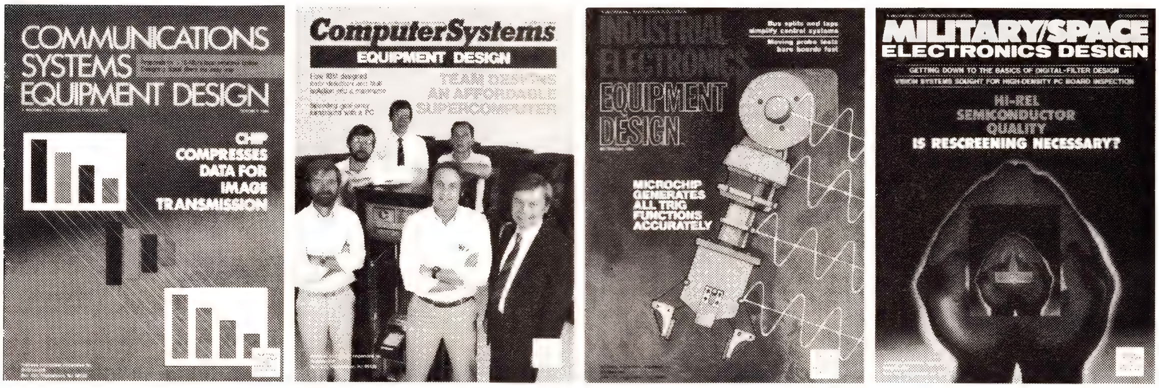
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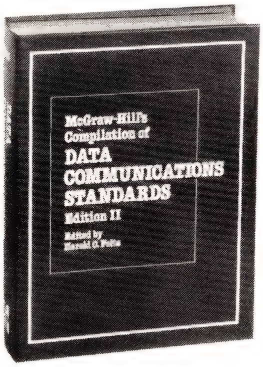
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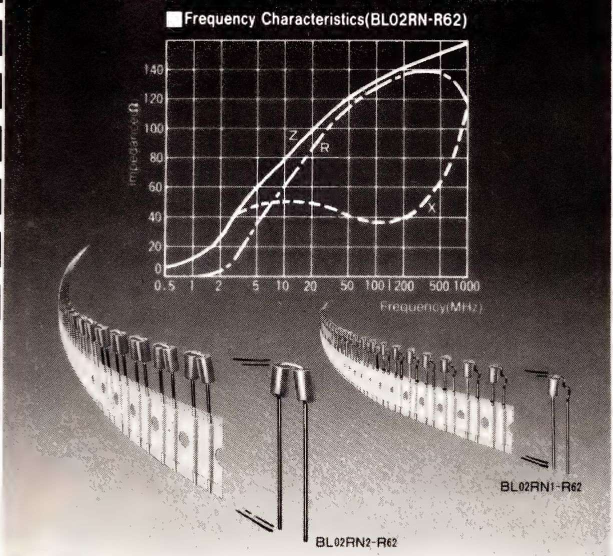

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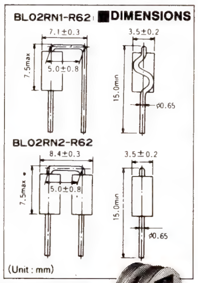

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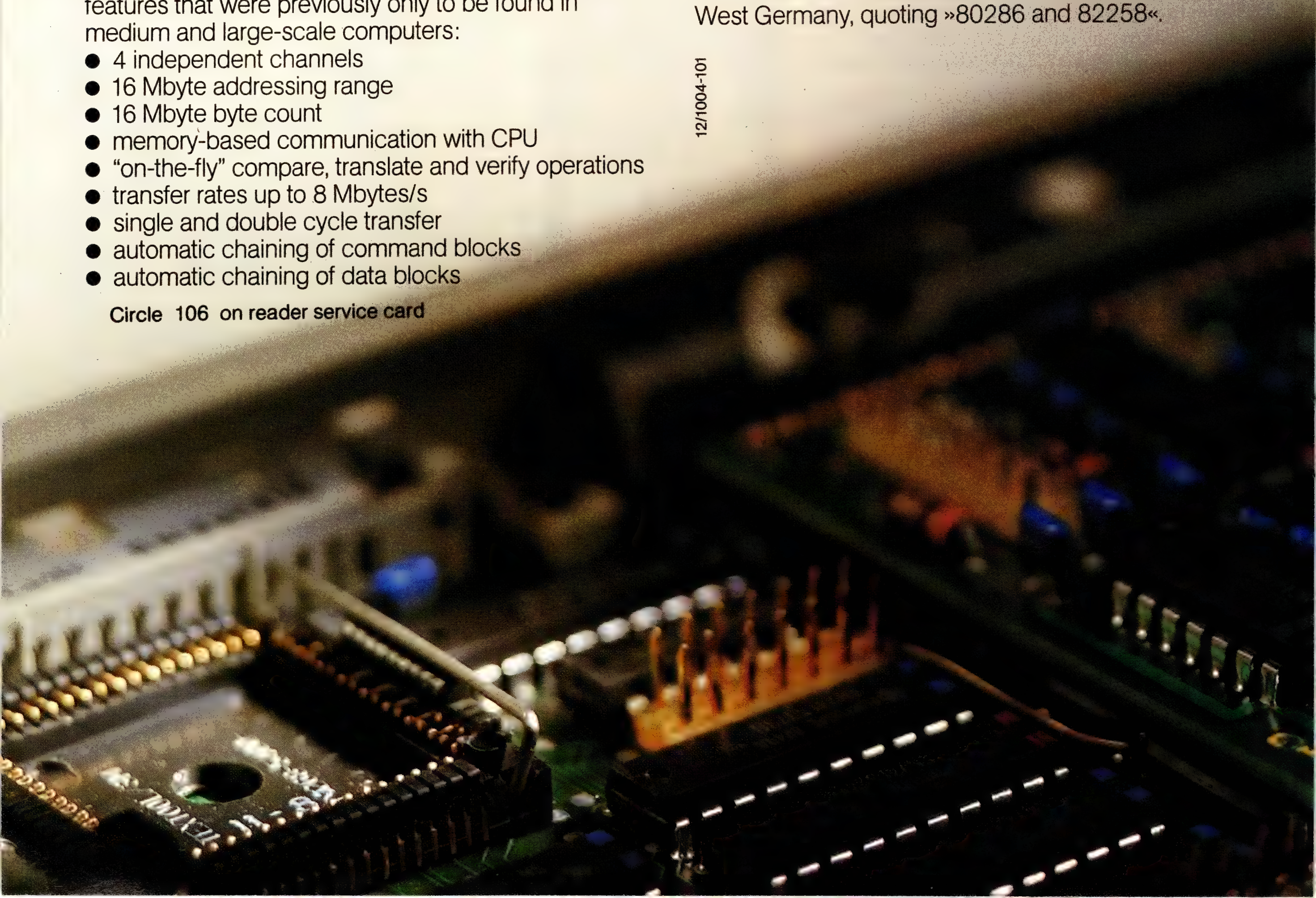

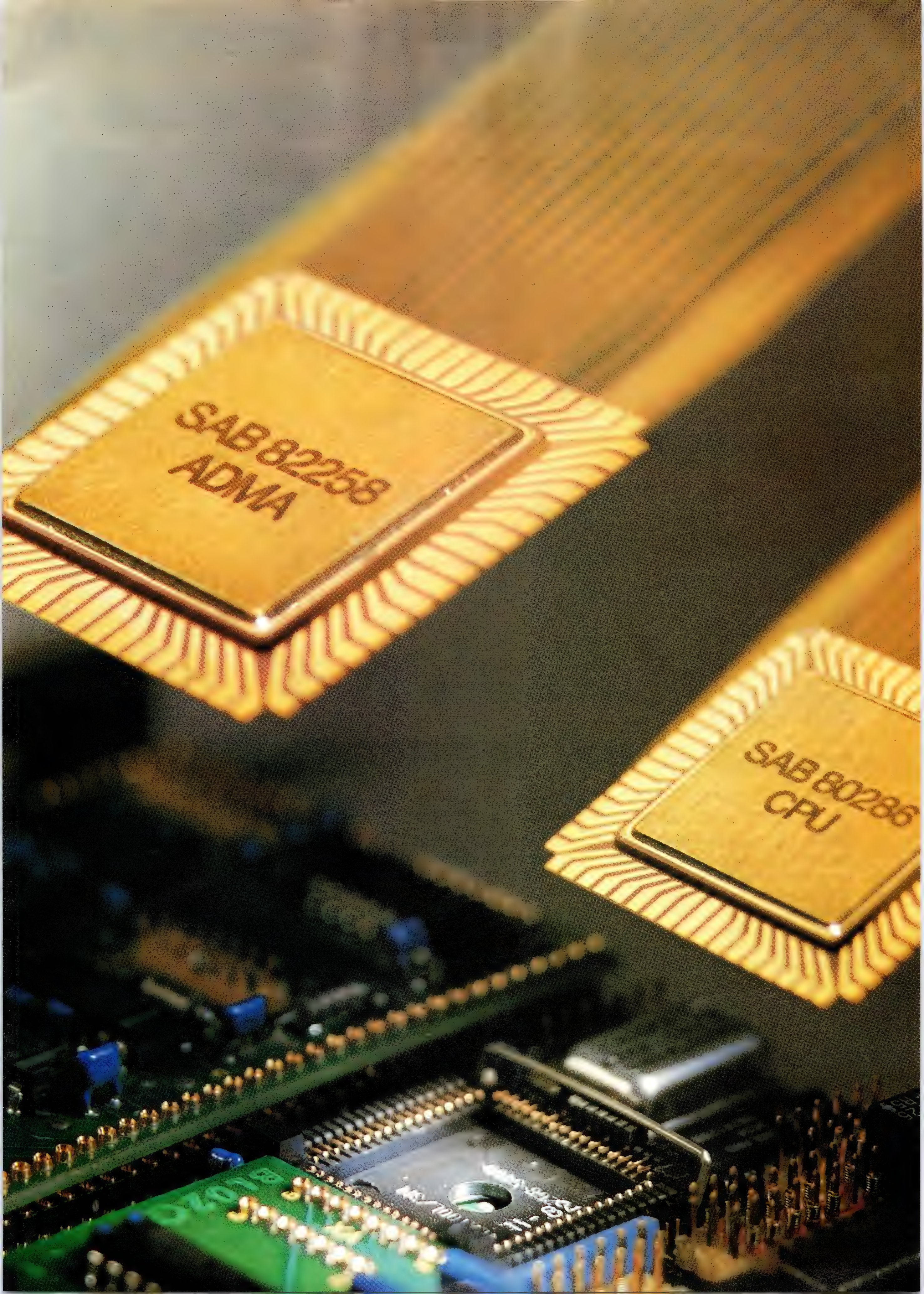
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CMU STARTS DOD SOFTWARE CENTER

Pittsburgh

Carnegie-Mellon University, having completed contract negotiations last month with the Department of Defense to establish a $103 million Software Engineering Institute here, has started to hire the first of 250 SEI staff members. The staff doesn't expect to move into permanent quarters near the campus, however, until January 1987.

The institute, the nation's first federally funded research and development center for software-engineering technology, aims to speed up the transfer of software-development tools and techniques from the research lab to practical application. The DOD announced its intention last year to help create, modify, and maintain software by establishing the SEI and opened competition among universities for the proposed institute. Carnegie-Mellon emerged the winner last November after an intense battle [*ElectronicsWeek*, Nov. 19, 1984, p. 8].

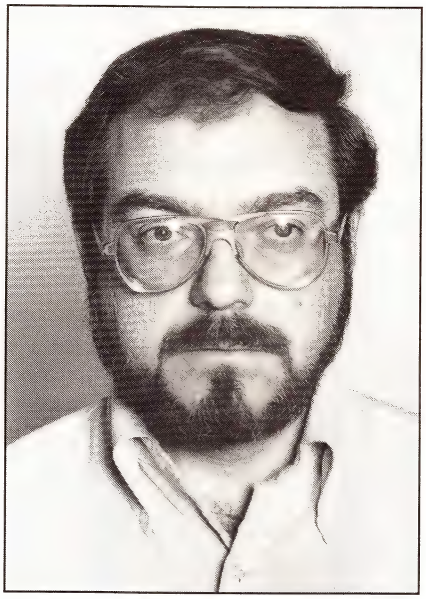
A mission of change. "The overall mission of [SEI] is technology transition," explains Mario R. Barbacci, SEI's associate director for project engineering and the principal author of Carnegie-Mellon's technical proposal to the DOD. Ultimately, Barbacci says, "We're going to change the way people [develop] software by using better tools."

Although the Pentagon is sponsoring the SEI, the DOD and university officials emphasize that its activities will, according to a DOD announcement, "exclude development of mission software for defense systems." The announcement says the DOD will continue to rely heavily on the private sector to fulfill its software needs and will control the institute's size. "The SEI is basically a catalyst," reports Edward Leiblein, the DOD's director of computer software and systems. "It's not going to take business away from anybody."

Carnegie-Mellon provost Angel G. Jordan sees the institute's primary responsibility as delivering the methods that the people at the DOD will use to develop their own mission software. "We cannot possibly do everything for them," Jordan stresses.

The selection of Carnegie-Mellon as the SEI site marks the first time that the federal government has used direct competition among universities to establish an R&D facility. Other bidders included groups from the universities of Maryland, Texas, and Michigan, as well as Georgia Institute of Technology, Texas A&M, and a joint venture from Boston and Northeastern universities.

Scary gamble. Unlike its competitors, says Barbacci, Carnegie-Mellon already had considerable experience in very large software-development projects—the type usually done by commercial software developers. Because of that edge, the university "took a gamble, because what we were proposing is perhaps very advanced and very different from the way they're doing things at the Department of Defense," he explains. "The risk we were taking was that we might scare the customers."



Gambler. Carnegie-Mellon's Mario Barbacci gambled and won with an ambitious proposal for the DOD's Software Engineering Institute.

Affiliates from industry and academia will send representatives to the institute for help in designing their own software tools. This educational method "guarantees the transition because it becomes really their baby," says Barbacci. "Therefore, they have a vested interest in actually using it at home."

He says the same prescription will apply to the DOD. "Whenever we identify a need or a particular organization within the DOD that could benefit from, say, a new program-development environment or some software-development tool, we definitely would like to have [that organization] send people on extended tours of the institute."

The DOD's Leiblein expects help from the SEI fairly soon and comments, "I think we'll see some benefits after the first year."

Planned projects. Three projects have been agreed upon for the first year. The first will evaluate two Ada programming environments: the Ada Integrated Environment being developed for the U.S. Air Force by Intermetrics Inc., and the Ada Language System that Telesoft is developing for the U.S. Army.

The second project will examine software-licensing issues emerging from contradictory court rulings. "The specific problem that the DOD has is that whenever it contracts for a piece of software, even if it gives the source code for it, very often that software is developed using tools that are proprietary," Barbacci points out. Just as the National Aeronautics and Space Administration has done, the DOD is seeking "ways to write the contracts so that it gets some kind of rights to the use of the tools," he says.

A third project will organize a workshop based on the concept of a "software factory." Barbacci describes it as "a very flexible programming environment that will evolve over a number of years."

In addition, Carnegie-Mellon has proposed a short-term demonstration project that could be developed in as little as six months and would be integrated into the model-development environment. –**George Leopold**

INVESTMENT SHIFTS IN AI

Venture money is tighter, but corporations are taking up the slack

☐ by Craig D. Rose

Boston

Venture capitalists sometimes liken their turf to an obstacle course and characterize themselves as daredevils racing in supercharged vehicles to the promised land of fast bucks. Corporations, on the other hand, tend to look at investments as a continuum leading to an eventual bigger bottom line—if not tomorrow, then maybe the day after.

In recent years, the venture people grabbed every vehicle they could find in biotechnology, robotics, and personal computers and made their run for the money. As a consequence, the course is now littered with wrecks, and many venture capitalists sustained wounds to their wallets and their reputations.

All this provides perspective to the current attitude toward investment in artificial intelligence. Clearly, most venture capitalists believe AI is another good bet, but one that should be viewed with caution as it enters a critical phase.

Though venture money moves carefully, however, the flow of funds from corporate sources has accelerated. This is partly because of what large companies perceive as the technology's maturation and partly because of a longer perspective on AI development.

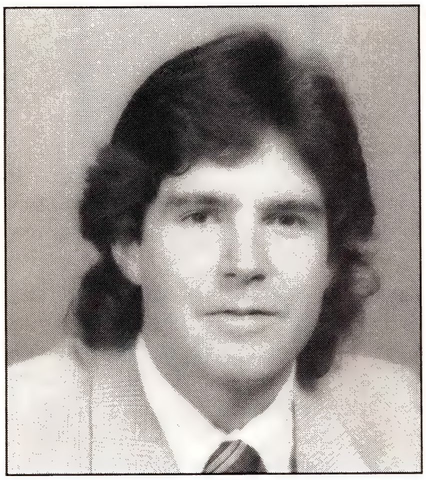
One reason for the conservatism of venture capitalists is that losses in recent years have contracted the overall venture market for high technology. As an additional burden to those seeking seed or early financing, AI is perceived as involving several magnitudes more risk than is the case in other high-technology areas.

What's more, some venture capitalists are reluctant to invest in anything that may have IBM Corp. as a competitor. Venture investors "became wary of high tech after they got burned last year by the personal computer market collapse," according to Harvey Newquist, the editor of *AI Trends* newsletter and a staff consultant at DM Data Inc., a research analysis company. He estimates that the total current investment in AI is less than $100 million.

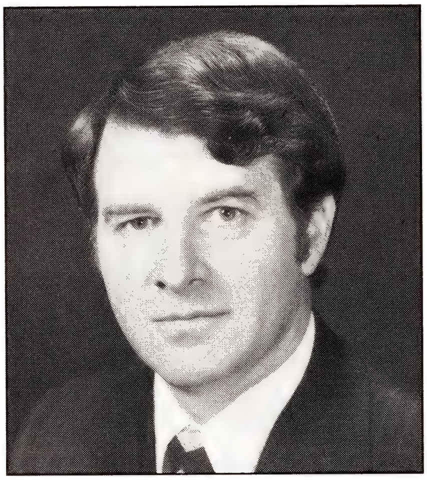
Grew wary. As a result of AI's "Gosh, wow" overselling, many venture funds grew wary of investing in the technology. Several industry observers emphasized that the large amount of media attention devoted to AI raised hopes unrealistically. "People invested in companies and they really didn't understand what they were investing in," acknowledges John Clippinger, president of AI firm Brattle Research Corp.

Venture capitalists are screening AI prospects more carefully these days and demanding more than just impressive technology. An exceptional product idea is no longer enough to open the vaults of the venture capitalists.

"We look at them seriously, but there are very few that have the necessary business elements to be good investments," says Eugene Pettinelli, a general partner in Fairfield Venture Partners. Pettinelli, then with another fund, was among the early supporters of Symbolics Inc., one of the most successful AI firms.



Put up or shut up. Analyst Harvey Newquist says the time has come for AI companies to turn out product. Should they fail to do so, he expects an investor backlash.



Looked outside. Bernard Chaput, of Boeing, invested in an outside AI research company to complement internal efforts. But the bottom line is still financial return.

Among the elements in a company that Pettinelli looks for as necessary for success are a good management team and a clearly defined market. "I'm being very cautious right now because there is very little relationship between the hype and the real potential of AI technology, especially in expert systems," he says.

Computing power. There is also the belief that tapping the full commercial potential of AI depends on events outside of the technology itself. Particularly important will be relatively cheap access to increased computing power, a requirement for most AI applications that was overlooked by some early investors.

David BenDaniel, an executive vice president of Genesis Group International Inc. and soon to be a professor of entrepreneurship at Cornell University, believes that AI will cross an important threshold when 50 million to 100 million instructions per second of computing power are available in the $50,000 to $100,000 range.

At that point, he says, "You can economically replace individuals who cost that much to do the same jobs." Moreover, as the price of hardware comes down, says Larry Wells, vice president of Citicorp Venture Capital, AI software will become an important market and "something equivalent to Lotus 1-2-3 might come along."

In the meantime, venture capitalists seem to believe that companies that are integrating AI technology into products, rather than companies that are focusing exclusively on the technology, are the best bets. "It won't be called AI," says Pettinelli. "I'm still looking for companies in which AI is an important but not an all-consuming part of what they're doing." Louis Davis, chairman of Churchill International, a fund based in San Francisco, agrees and says he is also on the lookout for "derivatives"—companies that would use AI technology.

Looked at as a technology whose applications can be integrated into products rather than as the complete focus of a business itself, McKinney says, "I think the economics of AI is much more here than people realize."

Also at hand is the time for smaller AI companies to move products out their doors. "From a marketing standpoint, 1985 will be the first year of considerable demand for this technology," says Newquist. "The AI companies will be forced to turn out products."

If they don't, he expects a backlash on the part of some investors. Nonetheless, some venture capitalists who have invested in AI say they understand the time involved in developing the technology more completely.

BenDaniel says that attitude is widespread. "Every venture capital operation has some crisis situation pending for which it is holding money in reserve. Some of the deals are for AI and, if things pan out, funding could open up again."

Companies invest. Corporate coffers have already opened to AI companies. General Motors, Boeing, Lockheed, Digital Equipment, Texas Instruments, and others have all recently made investments in AI companies. "As of 1984 and this year, certainly most of the AI financing will come from the bigger companies," predicts Newquist.

These corporate investments differ in that their objective is more the acquisition of technology than a return on investment. But corporate financing often includes other arrangements, such as licensing or distribution agreements. Corporate timetables also tend to be longer.

Boeing Computer Services Co., for example, invested late last year in the Carnegie Group Inc., a specialist in interactive knowledge-base systems. Bernard Chaput, business manager for Boeing's Advanced Technology Applications Division, says the investment was made so Boeing could keep up with the technology and use it to improve the quality and productivity in its business.

"Carnegie is quite

Discounts hype. Eugene Pettinelli sees "very little relationship between the hype and the real potential of AI technology, especially in expert systems."

Northeast AI research gets Air Force boost

The Air Force plans to rely on good old-fashioned cooperation to establish the Northeast as a major region for artificial-intelligence research. Recently, its Rome Air Development Center, in Rome, N.Y., drew together eight Northeastern schools to form the Artificial Intelligence Consortium, a five-year program to improve the Air Force's AI capabilities and stimulate regional involvement.

Each school will contribute research in its area of expertise. In return, it will get a share of the consortium's $8,236,000 contract. The member schools and their research interests are:

- *Clarkson University*—distributed problem solving.
- *Colgate University*—natural-language processing and plan recognition.
- *Rensselaer Polytechnic Institute*—image-understanding systems and aerial and satellite imagery.
- *Rochester Institute of Technology*—speech-understanding systems.
- *State University of New York at Buffalo*—versatile maintenance expert systems.
- *Syracuse University*—logic programming and special-purpose AI hardware.
- *University of Massachusetts*—intelligent user interfaces, natural-language generation and understanding, and expert-systems coordination.
- *University of Rochester*—problem solving, and temporal relationships and reasonings.

The Air Force Office of Scientific Research is cosponsoring the project with the center. The Air Force's Institute of Technology, at Wright-Patterson Air Force Base, will also participate in the program but not under the $8 million contract.

–**John Wengler**

strong in manufacturing applications of AI," he says. "This technology is getting more and more important to our plans. We're getting a better view now of how this could fit our plans for the 1990s. We're thinking of that time frame."

In assessing an investment for technology, Chaput says the company will compare the investment cost with the cost of doing the research on its own. He described the work done by Carnegie as complementing efforts going on internally and added that Boeing is evaluating other investment possibilities.

Future in aerospace. Lockheed Corp. recently invested in Inference Corp., an AI company in Los Angeles, for similar reasons. "It's pretty obvious that expert systems are destined to play an important role in aerospace," says Glenn Williamson, corporate director of diversification for Lockheed. He adds that his company also has a very large in-house AI effort under way. But he realizes that new companies have different approaches.

Dennis E. O'Connor, senior group manager for intelligent system technology at Digital Equipment Corp., says DEC invested in the Carnegie Group to "raise up its learning curve" in the area. At the same time, O'Connor says the company isn't looking for additional AI investments and is "doing more internally than we're doing with them."

The fundamental reason that large corporations are investing in AI now is because the technology is finally demonstrating at least the earliest signs of maturity. "Our AI program at Texas Instruments is seven to eight years old, but just in the last couple of years we have had specific plans for bringing products to market," says Joe Watson, vice president of the Data Systems Group at TI, an investor in Brattle Research and Lisp Machines Inc. And Générale de Service Informatique, a French company that has also invested in the Carnegie Group, plans to market AI-based products in personnel and human resources later this year.

"There are companies finally producing products now," says Newquist. "Finally, there are viable products for companies to invest in rather than just 20 engineers starting with an idea." □

TELEVISION

DIGITAL TV SET ALIGNS FROM AFAR

Freiburg, West Germany

A TV repairman makes a service call to adjust a misaligned set. He takes the set's remote-control unit and, without consulting a schematic or using measuring instruments, aligns the set just by pushing keys on the remote control and watching an image or test pattern on the screen. The controller links to the set by infrared beam.

This feat is possible with remote-control digital TV receivers built around the Digit 2000 set from Intermetall GmbH, lead house of the ITT Semiconductors Group here. This chip set is already used or intended for use by more than 20 TV makers around the world [*ElectronicsWeek*, Oct. 15, 1984, p. 50].

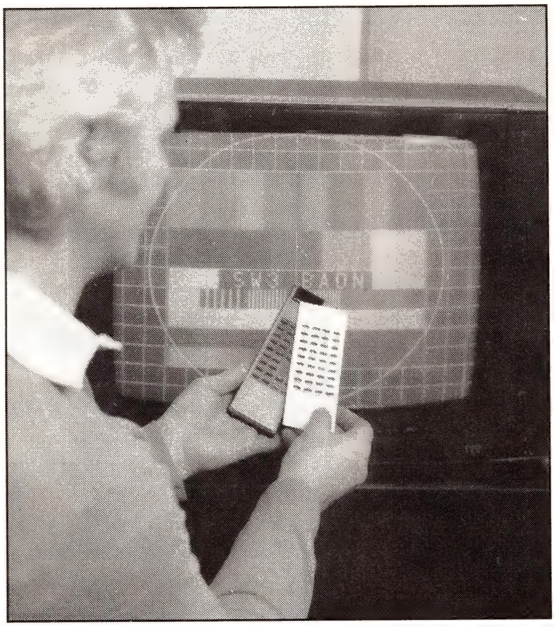
Implementing what Intermetall calls "integrated hands-off adjustment service" is software programmed into the chip set's central control unit, the CCU 2030. The 2030, with a 6.5-K-byte read-only memory, usually functions as an 8-bit microcomputer with two prime tasks. It controls the receiver's digital signal processors for video, audio, and deflection, and it processes various user settings, such as channel selection, station search, volume, brightness, and color saturation.

When accessed by the remote control, however, the 2030 can also make up to 17 adjustments, including such picture-geometry corrections as horizontal and vertical position and amplitude, trapezoidal and east-west curvature, and vertical symmetry. Color corrections include cutoffs for red, green, and blue (so that one color does not run into another) and electron-beam drive parameters for the RGB setting.

Room in the ROM. Intermetall engineers hit upon the idea of remote hands-off adjustments last summer, when they were wondering what to do with some spare ROM capacity in the CCU 2030. They found that the software needed for the 17 adjustments called for only 600 bytes of additional room in the ROM.

Intermetall will program the 2030 for all these adjustments and offer the chip as standard equipment to its Digit 2000 customers. But if a set needs fewer adjustments, as may be the case with some picture-tube concepts, the set maker can alter the program himself to suit his needs.

Beyond that, set makers can even program the Intermetall chip for remote adjustments entirely on their own. At least two Japanese digital TV set producers—Matsushita Electric Industrial Co. and Sony Corp.—started to do this even before the ITT company made its integrated hands-off adjustment service known.



Digital directions. A template fits over the remote control keyboard, listing picture adjustments. Symbols corresponding to them appear on the set's channel indicator.

In fact, a kind of remote-control scheme for digital TV sets already exists. It comes in the form of a "service computer" that the ITT Consumer Products Group in Pforzheim has been offering for its digital sets.

This sort of remote control is not wireless, however: a multiwire cable hooks the book-size keyboard-based service computer to the back of the set. The serviceman must also have access to this computer, which retails for up to $130 on the German market. The Intermetall method, by contrast, requires no extra equipment. What's more, it is cheap to implement, because it costs next to nothing to program the 2030 chip.

Easy alignment. Compared with the hour or so it takes to align a conventional analog TV (not counting the time it takes to get it to a repair shop and back), the hands-off adjustment technique moves along at express speeds. The repairman can run through all possible TV adjustments in less than 15 minutes, explains Hermann Zibold, a designer in the firm's Concept Engineering Department. What's more, the alignment can be done right in the user's home, regardless of whether the digital set was designed for PAL, Secam, or NTSC, or for any combination of the three.

The procedure starts with a switch in the rear of the chassis, which puts the set into the service mode. The repairman then places onto the keyboard of the remote-control unit a plastic template that lists all possible adjustments and their corresponding symbols. One keystroke puts the symbol for a particular adjustment on the receiver's light-emitting-diode display (usually, the channel indicator) and allows that geometry or color correction to be made.

The correction is made by pressing "positive" and "negative" keys, which change the picture geometry or color one way or the other. When the correct position or image is reached, the "load" key puts the corresponding digital value into an existing nonvolatile memory for permanent storage. This way, all adjustments are made sequentially.

The 2030's software package, designed by Zibold, contains information specifying which adjustment is being made, along with its minimum and maximum settings. –**John Gosch**

Newsbriefs

AT&T, 21 others to lay undersea cable in the Pacific

AT&T Communications, a unit of AT&T Co., has agreed with 21 other international telecommunications firms to build and maintain an undersea cable spanning the Pacific Ocean using laser-powered, digital lightwave communications technology. The fiber-optic system—to be called Hawaii 4/Transpac 3—will connect the U.S. mainland and Hawaii and continue across the Pacific to Guam and Japan. The system, which will cost $593 million and be operational on Dec. 31, 1988, will be the fourth cable between the mainland and Hawaii and the third cable from Hawaii to the western Pacific. It will be able to transmit the equivalent of about 37,800 simultaneous telephone calls. AT&T will install about 5,150 nautical miles of the system, while Kokusai Denshin Denwa Co. will install about 2,050 nautical miles. According to AT&T, final approval for the project must be obtained from the governments of the administrations involved, including the Federal Communications Commission.

Stocks of leading CAE work-station makers surge

The stocks of the three leading computer-aided engineering work-station companies—Daisy Systems Corp., Valid Logic Systems Inc., and Mentor Graphics Corp.—jumped 13% to 18% in the week following Tektronix Inc.'s announcement that it would pay a whopping $75 million for the second-tier firm CAE Systems Inc. Tektronix reportedly has had difficulty in developing CAE software for its own National Semiconductor Corp. 32000-based work stations and plans to adapt the CAE Systems software, which runs on Apollo and Sun Microsystems work stations built around the Motorola 68000 chip.

Metheus-CV sheds top officer

Meanwhile, yet another CAE firm, Metheus-CV Inc. made mid-January news by shedding its president and chief executive officer, James Towne. His departure stemmed from a move to set up closer ties with one of the firm's parent companies, ComputerVision Corp. (the other is Metheus Inc.). Ironically, it was at Towne's suggestion that Metheus hooked up with Computervision last year, to provide more software tools for its work station and more sales personnel for its products. The move eventually made Towne's job at the CAE company redundant; he has moved on to become president and chief executive officer of Photon Kinetic Corp., a maker of fiber-optics test equipment.

Apple/Sun laser printer unveiling

Apple Computer Inc. had barely presented its shiny new LaserWriter printer to the world last month in Cupertino, Calif., when Sun Microsystems introduced the same machine—bearing its own logo—at Uniforum in Dallas. Apple has never before allowed a major product to be sold bearing another company's brand name. Apple plans to sell the printer for about $7,000 and make it the centerpiece of its new office concept, called Macintosh Work Group, which connects the firm's Macintosh and IBM Corp. personal computers through a low-cost network called AppleTalk. The printer uses page-description software called PostScript, by Adobe Systems Inc., which stores fonts as mathematical formulas. Sun, maker of 32-bit Unix-based graphics work stations, will add about $1,000 and another Adobe package called TranScript, which allows Unix-driven output—until now politely called "device independent"—to emulate PostScript and be used by the printer. Apple plans to ship the product in March, Sun will follow during the second quarter.

AT&T, EDS to integrate communication, processing systems

A half-year after agreeing to merge with auto giant General Motors Corp., Electronic Data Systems Corp. is now driving hard into communications and data-processing integration markets with new partner AT&T Information Systems. Under a recently announced pact, AT&T and EDS will form project teams to identify and integrate tailor-made communications and data-processing systems. Both firms plan to market integrated systems worldwide.

SALVOS FIRED IN WAR ON WASTE

Congress joins with Pentagon in seeking to stem losses from skillful manipulation of the weapons-procurement process

☐ *by Alexander Wolfe*

Federal crackdowns, new legislative initiatives, and an increased emphasis on competition make up the latest salvo in the campaign to stamp out waste in the military procurement process. The waste ranges from $7,400 radiation-hardened coffee makers to multimillion-dollar overruns on aircraft and warships.

Two telling shots in the battle against waste will be fired in the upcoming session of Congress. In the House of Representatives, Rep. Barbara Boxer (D., Calif.) will push her "revolving door" bill to try to crack down on the hiring of government employees by military contractors.

To prevent conflicts of interest, the bill would mandate a five-year cooling-off period before government workers could move into certain private-sector jobs. If Boxer's bill is enacted, ex-government procurement officials would be prohibited from accepting jobs with a contractor they had previously monitored.

"There is a partnership between government and contractors rather than the healthy adversarial relationship that should exist, " according to Bernie Ward, a legislative assistant to Rep. Boxer. Observers think that the bill will probably pass during this session.

Meanwhile, the Senate will have before it a "creeping capitalism" bill being sponsored by Sen. Charles Grassley (R., Iowa), which mandates increased competitive bidding for military products and projects. In order to reduce Pentagon costs, the bill would place a limit on sole-source procurements. The Department of Defense would be forced to increase the dollar level of contracts that it awards competitively by 5% a year, until a 70% plateau is reached. At this time, only 6% of the Pentagon's contracts are competitive.

Legalities. As for the administration, it has already sallied forth to do battle with waste. The Department of Justice is currently suing to force Westinghouse Electric Corp. to hand over certain documents so that the company's Defense and Electronics Center in Baltimore can be audited.

A hearing in U.S. District Court in Pittsburgh is set for mid-February. The suit's outcome may have far-reaching effects because contractors now ignore half of all auditor requests for records. An audit is often the only way to substantiate allegations of fraud.

Boxer rebellion. Rep. Barbara Boxer's "revolving door" bill seeks to keep government procurement officials from moving over to cozy employment with defense contractors, a change from the current practice.

At the same time, the U.S. Army is investigating the hiring of eight retired officers by Ford Aerospace & Communications Corp., the contractor for the service's Divad antiaircraft gun. The Army has maintained that there is no evidence of wrongdoing and that the investigation is in response to a request from Army Under Secretary James Ambrose. According to latest reports, 2,200 retired military officers work at firms that do at least $10 million a year each in business with the Pentagon.

The government is not without teeth in its bid to combat poor performance by government contractors. In one of two major actions last year, the Department of Defense suspended $40 million in monthly progress payments to Hughes Aircraft Co.'s Tucson, Ariz., facility, citing shoddy workmanship on Navy Phoenix, Army TOW, and Air Force Maverick missiles.

"One of the most effective things that can be done is to withhold money until a contractor cleans up his act," states Donna Martin, project associate at the Project on Military Procurement. The private group, located in Washington, monitors defense issues.

Another case involves charges of falsely certifying Mil-Spec test data for integrated circuits. After the Defense Logistics Agency threatened to blackball National Semiconductor Corp. from further government sales, the company agreed to pay fines as well as institute stricter quality-assurance provisions.

Investigative coverage has increased in the past few years, notes Michael Eberhardt, assistant inspector general for criminal investigative policy at the Department of Defense. “Probably the most interesting phenomenon of the past several months is where you’ve had contractors making self-disclosure” of problems to the government in hopes of minimizing penalties.”

But aside from the Hughes case, which she considers encouraging, Martin of the Project on Military Procurement points out that “there really hasn’t been an example of a large contractor being suspended.” Adds Theodore Crackel, a senior fellow in defense studies at the Heritage Foundation, a conservative Washington think tank, “The difficulty is that we don’t seem to be able to fix responsibility” after auditing is completed.

Crying foul. To date, aggressive whistle-blowers within the government have found it rough going. A. Ernest Fitzgerald, a management systems deputy for the Air Force, is one example. He was at the center of a bureaucratic tug-of-war last year when his bosses fought to halt his testimony before a Senate judiciary subcommittee about excessive contractor labor charges of up to $3,400 an hour for Hughes’s Maverick missile. Fitzgerald is a strong advocate of “should-cost” pricing, which attempts to bring contractors’ hourly charges into line with the rates for private industry.

“I think it’s important to do should-cost data to show the public how badly we are being ripped off,” says Thomas Amlie, assistant to Fitzgerald for technical systems. Amlie came to prominence after leaking an internal Air Force memo that detailed revolving-door conflict-of-interest problems.

Amlie believes that the movement of retired government employees to jobs in the defense industry is a serious problem. “It’s not what they do when they leave [government], it’s what they don’t do when they’re in—stand up and make a fuss about high cost and poor quality.” But, he notes, “the ones that do get into serious trouble.”

Legislation to provide greater legal protection to whistle-blowers may be reintroduced in Congress. “I think we have to have a mechanism that encourages people like Ernie Fitzgerald to step forward and reveal problems,” says Crackel.

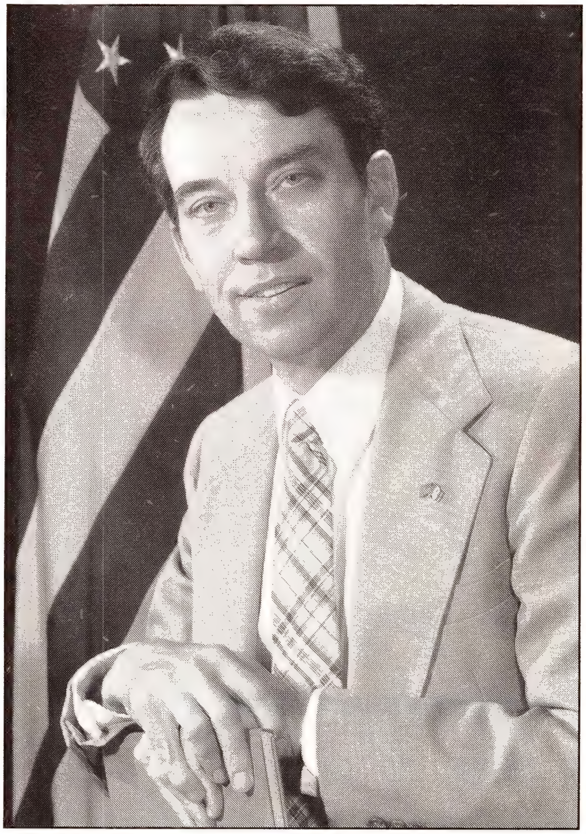
The growing acceptance in the military of the competition concept is shown in what are known as the competition advocate programs of the Army, Navy, and Air Force. The Navy’s chief competition advocate general, Commodore Stuart F. Platt, notes that there are some 300 advocates stationed throughout the Navy’s purchasing commands. “Obviously, if there are more missionaries, one impact may be more converts” to the philosophy of competition, he says.

Competition isn’t a universal solution, however. Crackel explains, “At the prime [contractor] level—shipbuilding, for example—there are many areas where we can’t have competition.”

And according to Sen. Grassley’s aides, the senator is “under no illusions that reversing the ingrained patterns of the Pentagon bureaucracy will be easy.”

One suggested solution is to use incentives, such as promoting people who save money and aggressively challenge contractors, to encourage the reduction of waste.

Miles to go. DOD Assistant Inspector General Eberhardt enumerates the seven deadly sins of the procurement game: overcharging, misbilling, product substitution, false claims, antitrust violations, bribery, and corruption. In the future, others are hoping to target gold-plated weapons systems, the ballooning costs of multiyear procurements, and poor warranties.



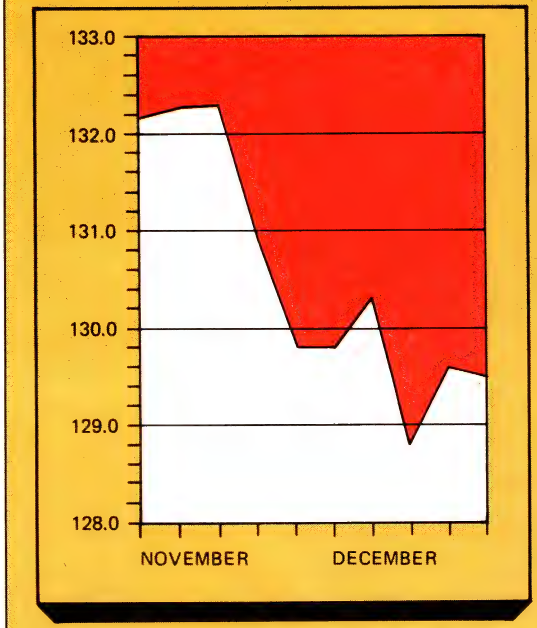
Cost conscious. Sen. Charles Grassley is sponsoring “creeping capitalism” legislation that mandates competitive bidding for military-procurement contracts.

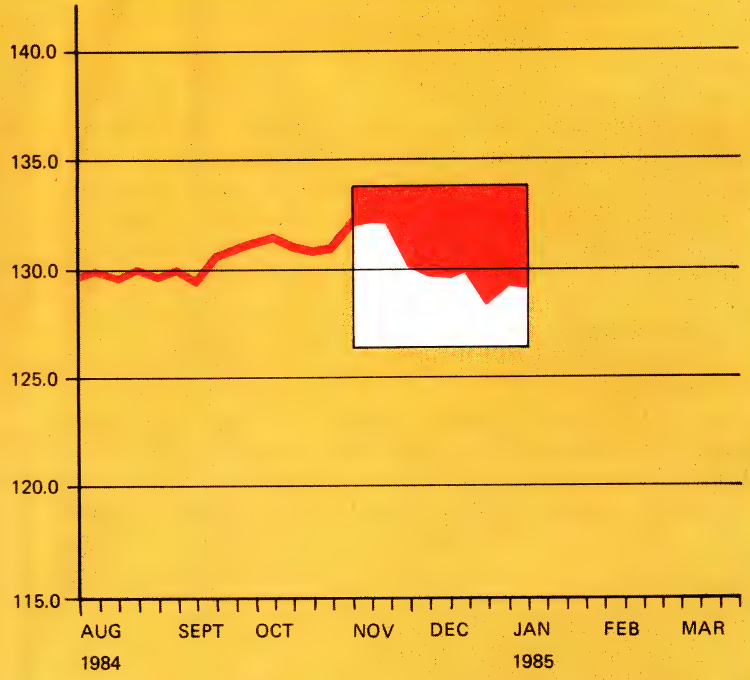
Attempts by the Department of Defense and other government efforts to remedy problems in the procurement process get mixed reviews. “The Pentagon, on paper anyway, is beginning to try to institute certain reforms. Whether it’s going to have a long-term impact is something we’ll have to judge,” says Martin of the Project on Military Procurement.

According to Crackel of the Heritage Foundation, “The whole perception that fools and felons run the procurement process is just not true.” But at the same time, “The Secretary [of Defense Caspar Weinberger] has not taken the lead and been sufficiently involved in the necessary changes” aimed at eliminating waste and abuse.

The negative publicity surrounding the work of military contractors has not soured graduating engineers on military work, however. According to Vicki Lynn, placement director at Rensselaer Polytechnic Institute, 60% of the school’s recent graduates have taken jobs in the field. “My sense is that it is increasing and there isn’t a whole lot of opposition to working for defense contractors.” ☐

ElectronicsWeek Index





THIS WEEK = 129.5
LAST WEEK = 129.6
YEAR AGO = 120.7
1982 = 100.0

The *ElectronicsWeek* Index, a seasonally adjusted measure of the U.S. electronics industry's health, is a weighted average of various indicators. Different indicators will appear from week to week.

U.S. ELECTRONICS ECONOMIC INDICATORS

	November 1984	October 1984	November 1983
Production workers (thousands) Office and computing machines	199.2	201.1	198.8
Communications equipment	292.1	291.5	267.7
Radio and TV receiving equipment	63.0	64.5	63.3
Components	425.5	425.9	375.3

U.S. GENERAL ECONOMIC INDICATORS

	December 1984	November 1984	December 1983
Average prime rate (%)	11.06	11.77	11.00
Retail sales ($ billions)	110.815	110.900	102.438
Unemployment rate (%)	7.1	7.0	8.1

Slipping employment levels across the electronics industry helped nudge the *ElectronicsWeek* Index down a fraction of a point in the latest week. The greatest fall in employment of electronics production workers, one of the components of the Index, came in radio and TV equipment manufacturers. But office machinery employment declined as well.

The drop in employment for the electronics industry mirrored the performance of the U.S. economy as a whole, as the national unemployment rate rose to 7.1% in December from November's 7%. Also on the broad economic front, retail sales fell a bit. Industrial production, however, posted a healthy 0.6% increase in December. An additional piece of good news points to a quicker-paced 1985 for electronics firms: interest rates continue to inch down.

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NEC NEWSCOPE

V-SERIES CMOS MICROPROCESSORS

NEC has unveiled the V-Series, a superior species of 16/32-bit CMOS microprocessors.

Ready for your evaluation are V20 and V30 16-bit microprocessors. The V20 has an 8-bit external bus, while the V30 is a full 16-bit machine. A powerful set of 101 instructions, dual data bus architecture and many other design refinements make these chips 50% faster than our 16-bit NMOS processors. Also power consumption is reduced by 70%.

The V20/V30 are supported by a full range of CMOS peripherals. A CMOS coprocessor (Floating Point Processor) is under development. The software package includes a proprietary real time OS, and development tools include an in-circuit emulator, relocatable assembler, Pascal and C compilers.

Shortly, peripherals hop on board. The V40 and V50 feature basic peripheral functions integrated on V20 and V30 silicon. The V25, complete with ROM, RAM, I/O port and serial interface, is a powerful processor for portable products.

The V20~V50 give you higher performance utilizing current software developed for our NMOS micros.

The V60 and V70 are 32-bit microprocessors with mainframe power. Features include an on-chip memory management unit and 4.3-gigabyte virtual memory.

The V-Series is second-sourced by Zilog, Inc.

C&C
Computers and Communications

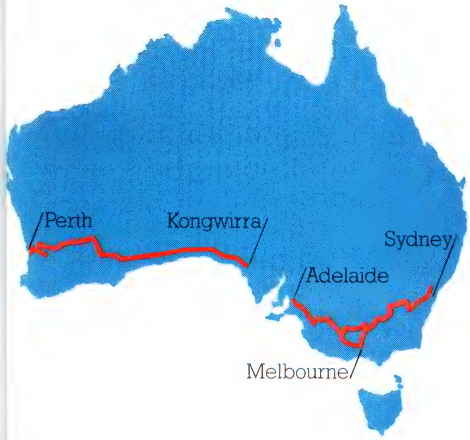
NUMBER 132

LARGE DIGITAL MICROWAVE LINK TO AUSTRALIA

NEC will supply Australia with a third large-capacity digital microwave system. Based on NEC's advanced 500-Series, it will span a total distance of 2,000km between Perth and Kongwirra in 52 hops.

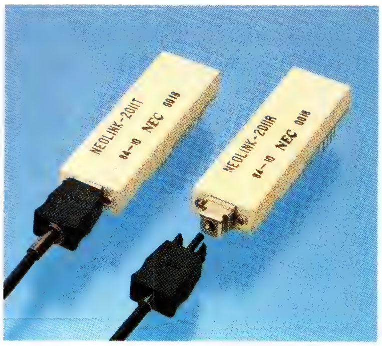
This new link will use NEC's 6.7GHz 140MB equipment with a capacity of 3,840 telephone channels, currently the largest available. The equipment is specially designed to operate in high temperatures, which top 55°C in the desert regions during the summer. Numerous advanced features, including adaptive and transversal equalizers and hitless switchover equipment, are incorporated to assure high speech quality.

The two previously supplied digital links are the 800km Sydney-Melbourne system and 650km Melbourne-Adelaide system. These also feature NEC's 500-Series 140MB equipment and accommodate 11,520 telephone channels.



NEOLINK™-2011 FOR HIGH-SPEED FIBER OPTIC LANs

Our new NEOLINK-2011, a pair of optical transmitter and receiver modules, enables the cost-efficient formation of reliable high-speed LANs without using LDs and APDs.



The NEOLINK-2011 combines a 1.3μm high-speed LED and PIN-PD. This ideal configuration takes maximum advantage of the low-loss, low-dispersion regions of graded index fibers.

The surface-emitting LED features 1.8ns rise and fall times and requires no thermoelectric cooling device. A newly-developed monolithic IC in the receiver incorporates AGC and line failure detection circuits and secures a 15 dB dynamic range. As a result, dependable high-speed digital transmission of up to 200Mb/s over a maximum distance of 3km is possible.

NEC's NEOLINK-2011 mates with graded index fibers of diverse core diameters. Interfacing with other systems is made easy by ECL level input/output and minimal restrictions on data formats.

The 9.5mm-high DIP design can be mounted directly on PC boards and runs on a −5.2V DC power supply. The built-in AGC eliminates circuit adjustments.

A low-profile, low-loss connector, with vibration-resistant lock, provides convenient snap-on connection.

NEC also supplies optical switches, couplers, fibers and all other components for LAN systems.

NEOLINK is a trademark of NEC Corporation.

THAILAND SELECTS MORE NEAX61 DIGITAL SWITCHING SYSTEMS

The Telephone Organization of Thailand (TOT) has again chosen the NEAX61 digital switching system. This time as the core of its fifth five-year telecommunications expansion project.

The contracts involve more than 870,000 subscriber lines (except for tandem switches) to expand the present digital network with new exchanges, including remote and cabin switches. When these new exchanges begin service, over two million subscriber lines will be served by NEC systems in Thailand.

The digital telephone network in Thailand features NCOM—NEC's Computerized Operation and Maintenance System. Incorporating the best of NEC's long experience and integrated computers and communications (C & C) technologies, NCOM provides comprehensive support using computers for the digital network—an important step towards the goal of ISDN.

NEC Corporation
Tokyo, Japan

CLEAN-ROOM INVENTOR WHITFIELD LEAVES A SPOTLESS LEGACY

Albuquerque, N.M.

As with many pivotal developments, the ultimate importance of the modern clean room escaped even its inventor, Willis J. Whitfield, during his epochal work nearly 25 years ago. "We had no idea of its significance at the beginning" recalls the holder of the patent granted in 1964. He retired in December, after more than 30 years as a physicist at Sandia National Laboratories here.

Since its invention, the laminar-air-flow clean room that provides a virtually contaminant-free manufacturing environment has permitted the sizing-down of integrated circuits to submicron geometries. Moreover, constructing the rooms has mushroomed into a major business itself, which amounts to some $300 million annually for the equipment.

Whitfield's initial assignment was to improve the existing clean rooms, where dust particles were fouling the components for the nuclear weapons that Sandia was assembling. He found that the clean rooms were unchanged since World War II, when they were used to assemble gyroscopes and bombsights. The rooms depended wholly on filtering out incoming contamination.

The problem was that erratic air flow could not clean the air fast enough. "It was like taking a bath in dirty water," he says. The system's best level was 100,000 particles/ft^3 of air—far too much for delicate components.

The solution looked simple enough to Whitfield. "My whole idea was to keep flushing the room out," through a large, uniform flow of filtered air (hence "laminar flow") sweeping downward. This meant covering the entire ceiling with air inlets and the entire floor with outlets. The result—an 8-by-10-ft room built in 1961—was an environment more than 100 times cleaner than the previous state of the art. "When the dust counters went to nearly zero, we thought they were broken," he says of the first test.

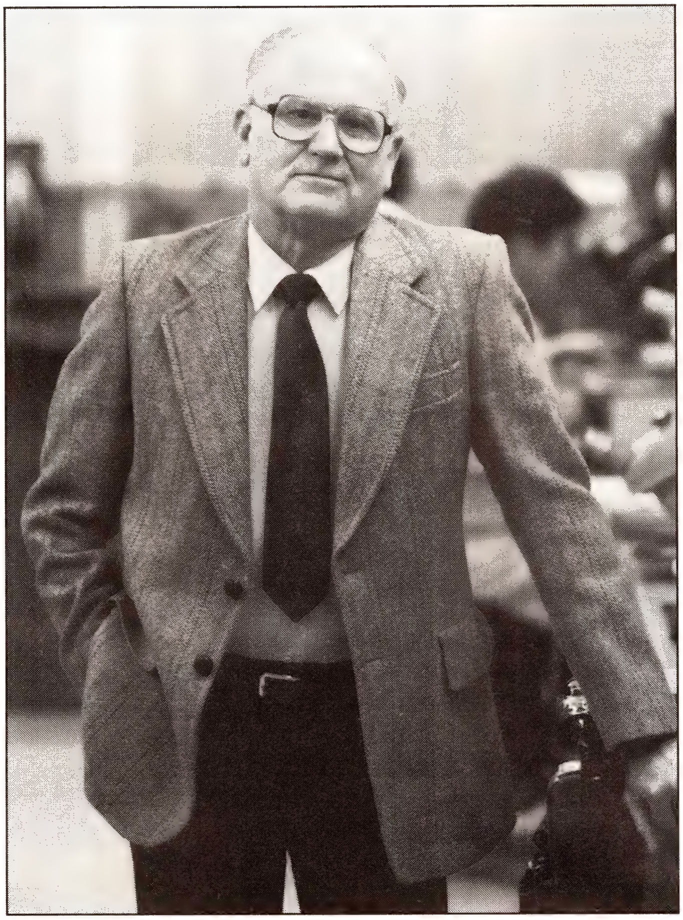
Unique design. Nobody was more surprised than Whitfield when the design turned out to be unique—and patentable. "I thought somebody else surely had done something like it, and they probably would have figured it out if we hadn't," he adds.

Word of his work quickly got around. Gen. David Sarnoff, color TV pioneer and head of RCA Corp., got in touch with Whitfield after reading about the clean room in *Time* magazine. He hired the inventor as a consultant in building a new video-tube plant. As the industry quickly adopted the clean room, Whitfield was called in to consult with Texas Instruments, Motorola, Western Electric, and other major companies.

Although the number of clean rooms in operation (about 2,000 in the U.S. and over three times that amount worldwide) shows the pervasiveness of Whitfield's discovery, his influence extends even further, says Claude Marsh of Cemco International Inc., a clean-room consultant. "It's not only the physical design of the clean room that's important, but the philosophy behind it," explains Marsh, a former colleague of Whitfield's at Sandia.

He defines this approach as "zero background," whereby contamination is eliminated instead of merely controlled. Whitfield's work thus became the backbone of federal standards set for clean rooms and stations.

Marsh notes that the improvements in clean rooms now come from equipment advances, not in refinement of the concept. The industry therefore keeps pushing standards for clean rooms downward; the Class 10 category permits no more than 10 particles/ft^3, for example. **–Larry Waller**



Mr. Clean. Willis J. Whitfield's epochal work on contaminant-free environments made today's submicron technologies a reality as it also created a major new business—the building of clean rooms.

SEMICONDUCTOR VETERAN SEEKS FAIRCHILD'S FORMER GLORY

Mountain View, Calif.

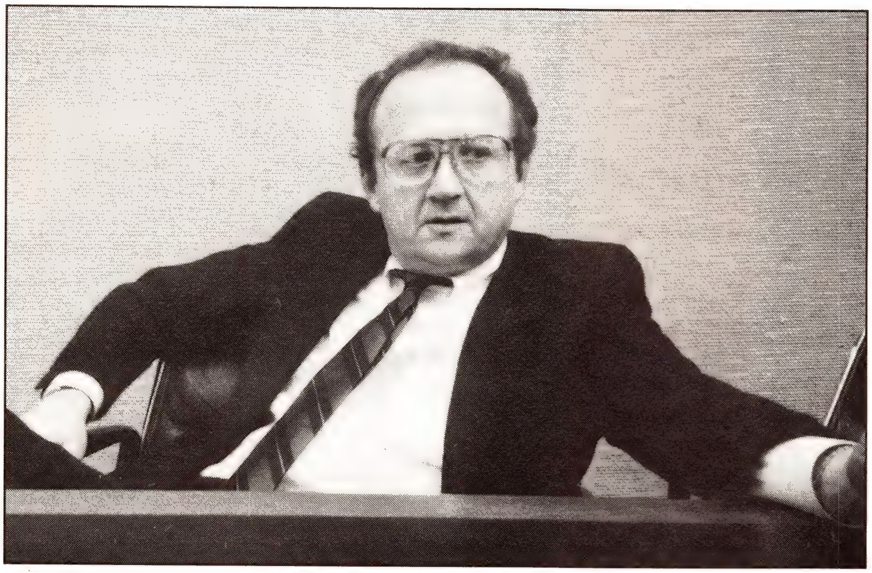
Giving Donald W. Brooks the title of president and chief executive officer of Fairchild Camera & Instrument Corp. last month only made official what had been a working reality for well over a year. During that time, Brooks had been working to restructure the once-leading semiconductor manufacturer from his position as executive vice president of its North America Semiconductor Group.

Though the promotion entails few new duties—Brooks's former position won't need to be filled—it means that after five years as a ward of Schlumberger Ltd., Fairchild has officially been returned to the control of a semiconductor specialist.

Fairchild, the legendary success of the 1960s, lost its touch in the 1970s and finally succumbed to a takeover bid from the French oil firm in 1979, to avoid being swallowed by Gould Inc. Schlumberger picked one of its financial vice presidents, Thomas C. Roberts, to run the subsidiary. Roberts, who had no experience in semiconductors, presided over a restructuring of the company that included severe cutbacks in personnel, particularly in marketing.

Roberts carried Schlumberger's low-key corporate style to an extreme, and an Iron Curtain-like silence descended around Fairchild, once one of the most flamboyant companies in Silicon Valley. Behind the veil, Roberts invested heavily in capital equipment and in research and development. Those expenses, coupled with Fairchild's loss of market share, resulted in four years of red ink.

Brooks, 45, came to Fairchild in the spring of 1983, after 26 years at Texas Instruments Inc., his only other employer since he graduated from Southern Methodist University. He had taken part in almost every phase of TI's integrated-circuit activities, working with Jack Kilby on the design of the first planar IC, helping to write the original proposal for the Minuteman missile project, and serving as general manager of TI's linear and digital product operations.



The force is with him. Donald W. Brooks is counting on aggressive new product development to help transform Fairchild into a force in the CMOS business.

Most recently, he made TI into a leading supplier of MOS memories. Fairchild, known as a bipolar specialist, hadn't been able to put a dent in the MOS memory market despite its intermittent efforts over a 15-year period.

"One of my two main jobs has been to bring MOS technology to Fairchild," Brooks says. With a new 2-μm CMOS process and a 32-bit CMOS microprocessor in the wings, he feels ready to test that market. A 64-K-by-1-bit static random-access memory will be introduced this week. This memory can be put to work in large minicomputers, mainframes, and supercomputers that use large word structures.

By 1988, Brooks says, CMOS will account for some 30% of Fairchild's revenues (less than 10% of its sales are now in MOS).

Goes in-house. Fairchild has the rights to second-source the 16-bit version of National Semiconductor Corp.'s 32000 series MOS microprocessor. But it is not making the chip, and Brooks says the agreement is dormant.

The Fairchild 32-bit chip, says the company's president, will be a new design that suits it for specific applications in computer-aided design and very large-scale integration testing.

Brooks says his other main task has been "to decide what business we're in." The company will not be a broad-line supplier of semiconductors. Brooks has organized it into independent units—focusing on high-speed bipolar logic, a bipolar microprocessor built for the Air Force, gate arrays, and CMOS. He has also brought in a team of TI executives and strengthened the marketing force.

"We are going to bring new products to market at a much higher rate," claims Brooks. "We have a chance to gain market share. The market for high-speed emitter-coupled logic, memory, and gate arrays for mainframes is a little stronger than the personal computer market."

Fairchild reportedly squeezed a small profit out of sales of some $720 million last year. Wyle Laboratories, an El Segundo, Calif., distributor, has evidence that Fairchild is already beginning to make a comeback. "We have quadrupled our sales of Fairchild parts since Brooks took over," reports Wyle Labs vice president Charles Clough.

As a former colleague of Brooks at Texas Instruments, Clough knows what Brooks can do. "People who think Fairchild is finished are not familiar with what Brooks did at TI. He will put Fairchild in the MOS business. It may take five to seven years for the company to become a major factor—but Brooks has the capability to do it." **–Clifford Barney**

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"When we approached Eaton we were looking for a partner."

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Otis Wolkins, President
GTE Microcircuits Division

Circle 41 on reader service card

SEMICONDUCTOR STARTUP BRAVES INDUSTRY SLUMP

Sunnyvale, Calif.

With sales slumping and firms laying off workers, it hardly seems an auspicious time to get into the semiconductor business. But James V. Diller, president of Sierra Semiconductor Corp., is certain his year-old company will thrive. The market slump "couldn't happen at a better time," he maintains.

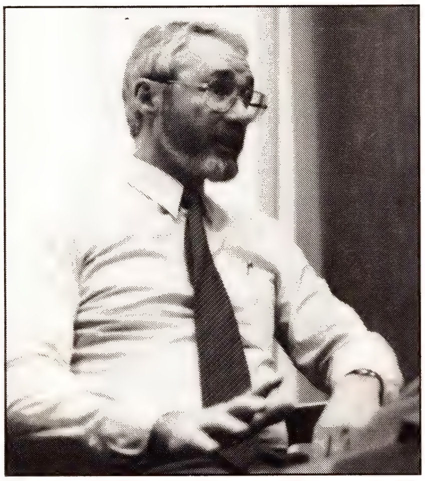
Diller believes that Sierra will be on target in the fast-growing segment of the market that it has picked: full-custom CMOS application-specific integrated circuits. Sierra is producing a system on a chip—combining electrically erasable programmable read-only memory, analog, and digital functions—that will be particularly useful in data and telecommunications applications, Diller says. Through strategic alliances that will shorten Sierra's development cycle, the company will also be geared up in time for the market's rebound.

Joining forces. In December, Sierra signed a technology-exchange agreement with VLSI Technology Inc., a well-established design service and manufacturing firm that also competes in the application-specific IC business. The agreement gives Sierra immediate access to VLSI Technology's software-development tools for computer-aided design as well as its cell-compiler library.

In exchange, VLSI Technology gets an analog-cell library from Sierra and certain analog-product rights. The design compatibility also provides both companies' customers with second sources. Diller points out that this agreement will help to cut Sierra's design-cycle time and considers this to be "tremendous leverage for a small company."

Equally important to Sierra's ramp-up was a technology exchange signed in July with National Semiconductor Corp., which provided a developmental 5-in.-wafer line for Sierra within National's own facilities. Space was acquired easily from the major semiconductor manufacturer because all of Sierra's top management—Diller and his four vice presidents—left National to form the new company.

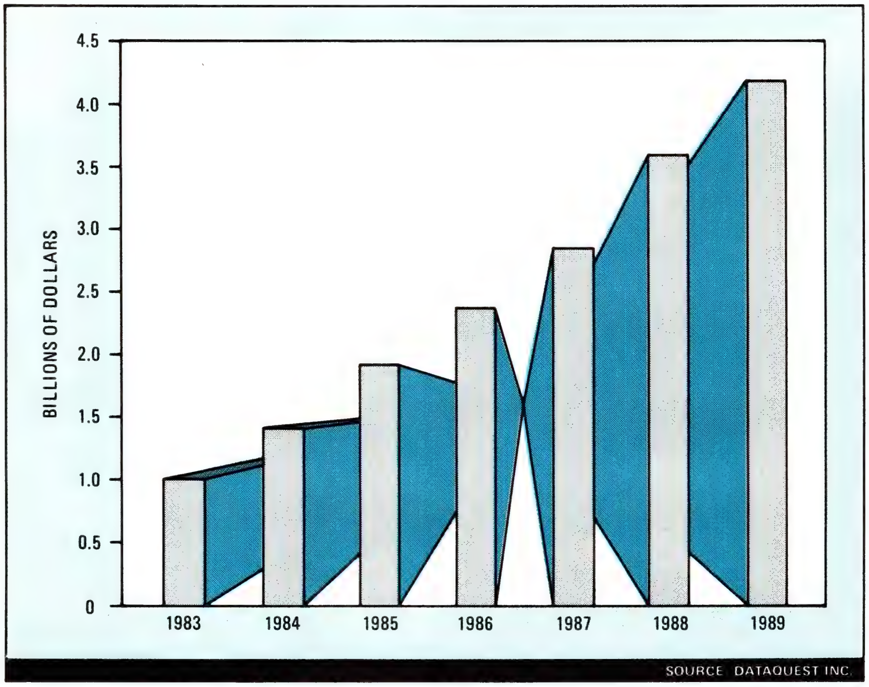
Diller believes his company has avoided legal complications (such as allegations of theft of trade secrets) with his former employer because Sierra will sell to a different market and because of what he describes as "a very unusual situation when we left." Sierra's founders all left National over a period of time and kept their former employer informed of their plans.



Optimistic. The semiconductor slump "couldn't happen at a better time," says Sierra Semiconductor president James V. Diller.

Studied well. Market analyst Andrew Prophet of Dataquest Inc. likes Sierra's choice of application-specific ICs as an entry point. "It's done its homework very carefully," he says. Prophet notes that recent Dataquest figures show the market for full-custom application-specific ICs will grow at a rate of 26% annually through 1989, when it will total \$4.2 billion, or about 7.6% of the expected \$55.4 billion worldwide merchant IC market.

Because Sierra has yet to ship any products, Prophet has taken a wait-and-see attitude toward the firm. He points out, however, that "it has good financial backing and it has a



SOURCE: DATAQUEST INC.

Fruitful. The market in which Sierra Semiconductor participates—application-specific integrated circuits—totaled \$1.4 billion in 1984 and should hit \$4.2 billion by 1989.

good management team."

Soon after the company's founding, in November 1983, Sierra secured $8 million in equity financing and a $15 million lease line for capital equipment a year ago. Construction has begun on its new headquarters in San Jose, Calif., which will also house production lines for 6-in. wafers. Diller says second-round financing will occur in March.

"We're right on our original business plan," Diller says, a process helped along by the fact that the first wafer through the firm's development line worked. And the executive appears comfortable with the volatility of the semiconductor market. Rather than seeing the competition fall away, Diller believes "the business will be characterized by more suppliers—driven by service and the ability of suppliers to get solutions in a timely fashion." **–Eve Bennett**

IMAGING TECHNOLOGY BREAKS FROM THE GATE

Woburn, Mass.

Even without state-of-the-art imaging hardware, the writing on the wall is clear: there's a lot of money to be made in the industrial vision business. But when Imaging Technology Inc. started up three years ago, its founders didn't just want to make a lot of money—they wanted to make it immediately.

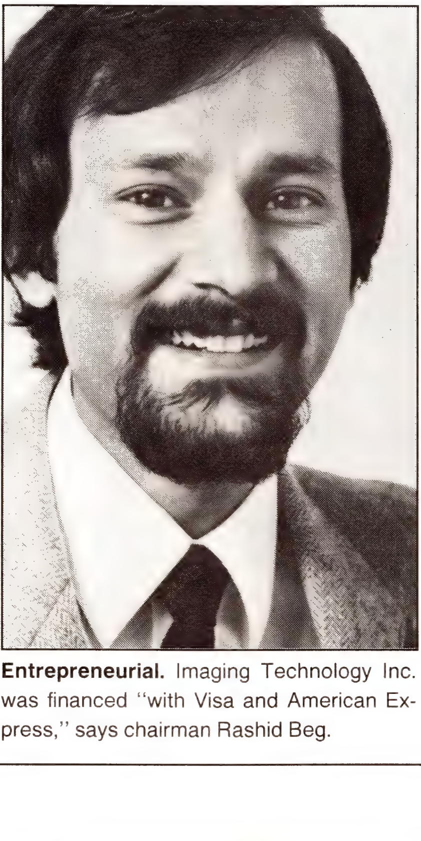
This desire was motivated more than a little by the location of their corporate headquarters, which was an extra bedroom in a founder's home, and by the limits of their venture capital, which were defined by the credit caps on their charge cards. "We financed it, I like to say, with Visa and American Express," says Rashid Beg, chairman and executive vice president. Adds Stephen Silver, company president: "In our third month, we shipped almost $80,000 in products. We had a profitable first quarter."

To be sure, this was a modest start in an industry expected to grow to $1 billion by 1990. But along the road to that milestone lies a series of shakeouts and bankruptcy proceedings. Industry sources now estimate that more than 130 companies are jockeying for just $170 million in annual sales currently.

Within this diverse market, Imaging Technology claims over 4,000 installations, making it a leader among the handful of companies manufacturing board-level components. In its current fiscal year, the firm expects revenues of over $9 million, double its income from the previous year.

The backbone of the ITI product line is the IP-512 family of modular products for the Q-bus and Multibus architectures, which includes frame buffers, analog processors, image processors, feature extraction modules and color video digitizers. The idea for modular products was Beg's, an engineer who worked previously at Datacube and Matrox Electronic Systems Ltd. He had been impressed by the number of people who wanted imaging capability and with the diversity of their needs.

"People needed the ability to build custom systems out of basic building blocks," says the 35-year-old Beg, who was born in India. The technology to meet those needs was available, but only as part of very expensive systems. Imaging Technology's task was "figuring out how to porthole the logic into a family of products that was highly modular."



Entrepreneurial. Imaging Technology Inc. was financed "with Visa and American Express," says chairman Rashid Beg.

When the cost of that technology is brought down into the $50,000-and-under range, "the market changes dramatically in terms of who's willing to pay," says Silver, a 39-year-old native of New York.

The idea of a modular family of plug-compatible products has served the firm well. It moved from the bedroom to a storefront in New Hampshire and now occupies 20,000 ft^2 in an office building. Imaging Technology has 70 employees, including a dozen engineers.

Underscoring the firm's emphasis on high profitability, Beg says initial designs went straight to printed-circuit boards, bypassing prototypes. "If one is confident enough of what he's doing, prototyping is unnecessary," Beg claims. "But as the design becomes more complicated, the need for prototypes does arise." Adds Silver: "Considering all our products were six layers, it points to how good Rashid is. It also points to luck."

VMEbus coming. Later this year, plans call for the introduction of products for VMEbus architecture. The company says it has about 400 customers, including some end users and many original-equipment manufacturers. The market position suits Silver just fine, since he anticipates that while some customers will experience explosive growth and others fall by the wayside, the firm will rise with the industry as a whole.

At least one industry observer believes that firms making board-level components will face tough going over the long haul in the machine-vision business. "Most machine-vision companies build their own components," says Perry West, president-elect of the Machine Vision Association of the Society of Manufacturing Engineers. Because many of the entrepreneurs in the business are engineers, West says, "Traditionally, the 'make-or-buy' decision has favored the 'make.' "

Still, Silver thinks the firm has created a new market for real-time image-processing components. He acknowledges that this embryonic market may not develop quickly, given the time needed for integration, but adds, "We are allowing more people to implement applications that are affordable." **–Craig D. Rose**

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LASERS FIX DYNAMIC RAMs

Redundant design and laser repair can double production line output of working dice quickly and economically

☐ *by Donald M. Stewart*

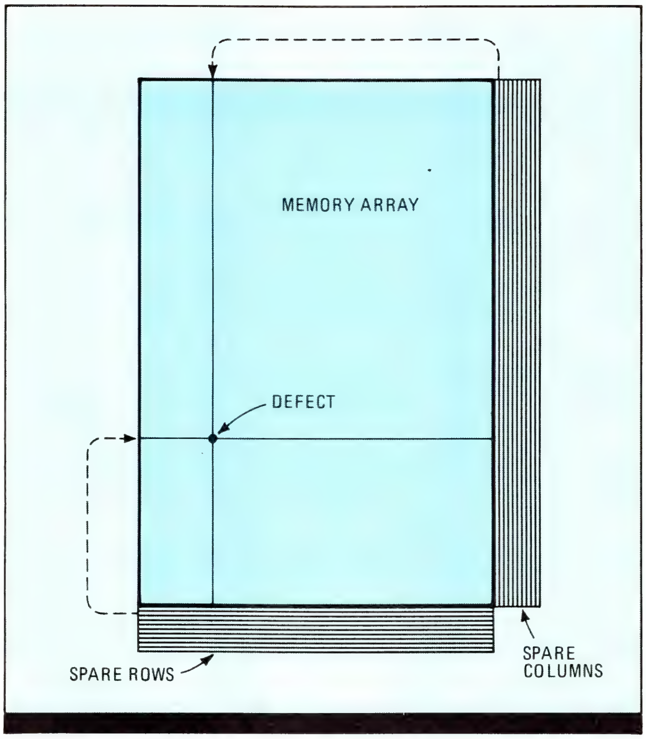
Redundant design, which was found to be a powerful yield-enhancing option when memory densities peaked at 64-K, has become an indispensable tool for manufacturers facing today's booming worldwide demand for 256-K DRAMs. By equipping dynamic random-access memories with spare bits to replace defective circuitry, redundancy can quintuple the yields of working memory chips. Redundancy also promises to extend its benefits to the 1-Mb DRAMs now being developed, not only as they move into production later in this decade but throughout their entire market life.

In conjunction with a memory-repair process in which a laser beam is used to disconnect defective memory circuits and activates good redundant spares in their place, redundant design affords economic advantages currently being demonstrated on 64-K and 256-K DRAM production lines.

Mostek Corp., for example, has calculated that using redundancy and laser repair can double an existing production line's output of working memories, at approximately one fifth the capital cost and in about half the startup time as would be needed to double front-end capacity.

Such economies will continue to apply as 1-Mb DRAMs move into production. An analysis of factors affecting 1-Mb-DRAM yields shows that laser-repair equipment as currently configured (that is, in combination with a memory test system) will pay for itself in less than a month while these parts are still immature. Even as the 1-Mb DRAM reaches maturity, the following analysis projects the payback to be under 14 months.

In a redundantly designed dynamic random-access memory, spare circuitry consists of extra rows and columns (Fig. 1) that can be substituted for a row or column that contains a defect in the regular memory array. For a 1-Mb memory, the redundant circuitry imposes only a slight area increase—approximately 1.5%.



1. Chip savers. Redundant rows and columns bordering a dynamic random-access memory's regular memory array can be connected as replacements for rows and columns on which defects have occurred. A laser-based repair system performs the substitution.

Once a memory test system has identified defective memory-array rows or columns on a chip, the laser-repair system produces a pulsed laser beam that vaporizes polysilicon links on the chip to disconnect the defective circuitry. Cutting links also logically connects a good redundant row or column and programs the memory chip's decoder to recognize it.

On a 1-Mb DRAM, these poly links will measure approximately 1.5 μm in width; the centers of two adjacent links will lie only about 4.5 μm apart.

A 1-Mb part contains several thousand links. On the average repairable die, replacing bad circuits with good ones requires laser cutting of 50 to 200 links, each hit with a single pulse of the laser.

To repair a die successfully, the laser beam must strike its targets without disturbing adjacent links (see "How laser repair works," p. 48). Thus a laser-repair system's ability to align the die precisely, position the laser beam, and control the laser pulse's energy and spot size is crucial to achieve redundancy's full yield-enhancing potential. With consistent repair-system performance, fix-to-attempt success rates hover at 95% or better—essential for 1-Mb DRAM production.

Gross and unrepairable defects (usually the result of mask misalignment and similar processing errors) are characteristic of the early production phase. These drop to 10% or less of a production run as the fabrication process for a new part is brought under control. But random failures that affect individual bits on a single row or column, such as pin holes and missing or extra metal interconnections or diffusion patterns, decline more slowly during production. Fortunately, the laser can repair this kind of defect.

Defect distribution

Random defects can occur at many points, given the 30 or so separate fabrication steps that go into a 1-Mb DRAM. Defects may be evenly distributed, or they may appear in clusters. Although both the number of defects and their distribution have a major impact on the yield of a wafer, the variation in the yield based on the distribution of defects can be substantial.

For example, if defects are evenly distributed throughout the wafer, as has been modeled by the Poisson distribution [*Electronics*, July 28, 1981, p. 118], an unrepaired wafer with an average of 0.75 defects per die would yield 43.5% of its dice as working memories. But if defects cluster, leaving areas with few or no defects, an unrepaired wafer's yield can rise as high as 67%. (Both of these examples assume a yield of 92% to account for mask misalignment failures.)

A number of statistical models, including the Poisson and Price distributions, have been developed over the years to predict the impact of defect density on semiconductor yields. To take full account of both defect density and defect clustering, however, the following analysis uses generalized negative binomial distribution (GNBD).

Statistical base

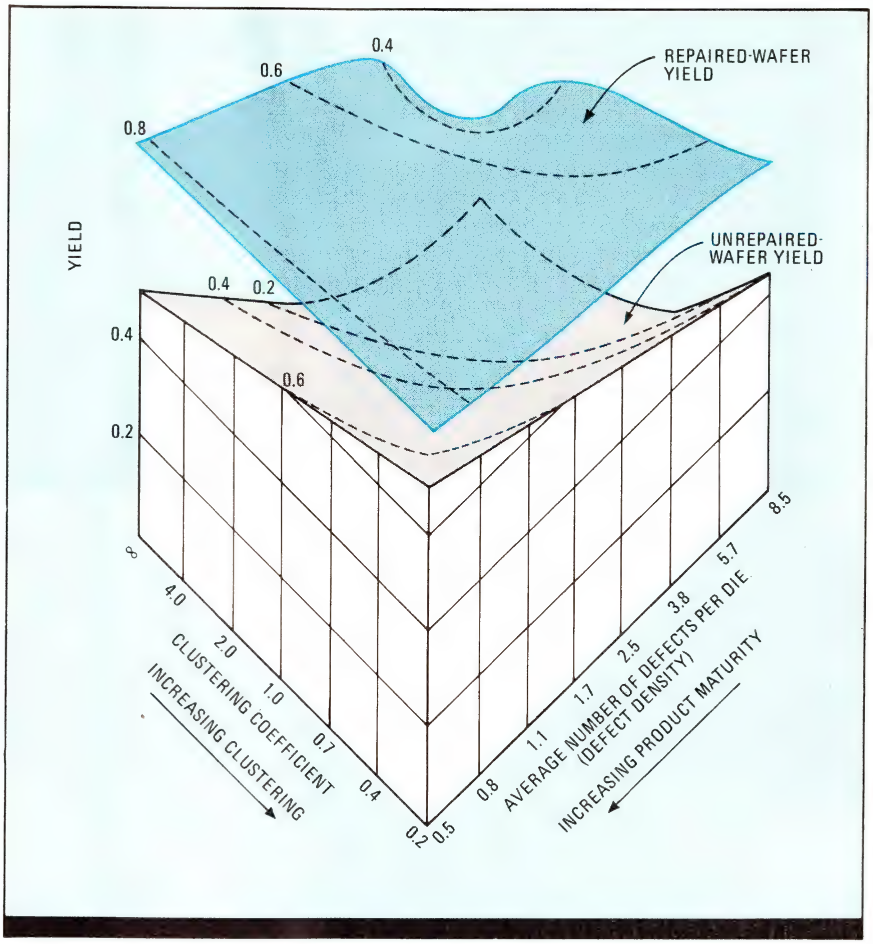
The selection of GNBD statistics is based on work by Charles H. Stapper,[1,2] a senior engineer at IBM Corp.'s General Technology Division. Stapper showed that GNBD closely models the realities of defect density and defect clustering observed on semiconductor processing lines. In addition, it is mathematically consistent with both Poisson and Price distributions.

GNBD statistics assume that the probability of a defect increases in direct proportion to the number of defects already present: if several defects already exist on a die, another one is far more likely to occur there than if there were none. In processing, clustering of defects shows that the defects result from events such as a disturbed filter that dislodges dust onto the wafer or a

TABLE 1: 1-MB DRAM YIELD

Average number of defects per die (defect density)	Clustering coefficient (increasing clustering ——→)						
	(Poisson distribution, no clustering) ∞	4.000	2.000	(Price distribution) 1.000	0.700	0.400	0.200
0.500	81.0 55.8	81.1 57.4	81.2 58.9	81.3 61.3	81.4 63.1	81.7 66.5	82.5 71.6
0.750	75.0 43.5	75.3 46.3	75.4 48.7	75.9 52.6	76.2 55.3	77.2 60.3	79.0 67.4
1.125	69.9 29.9	70.9 34.1	71.6 37.7	72.7 43.3	73.4 47.0	74.9 53.9	77.5 63.0
1.688	62.0 17.0	64.4 22.5	65.8 27.1	67.9 34.2	69.2 39.0	71.6 47.5	75.3 58.7
2.531	52.8 7.3	57.8 12.9	60.6 17.9	64.1 26.1	66.0 31.5	69.3 41.5	73.8 54.5
3.797	40.8 2.1	49.4 6.4	53.7 11.0	58.7 19.2	61.5 25.0	65.9 35.9	71.6 50.5
5.695	28.1 0.3	41.7 2.7	48.0 6.2	54.8 13.7	58.3 19.6	63.7 30.9	70.2 46.8
8.543	16.0 0.0	34.1 1.0	42.4 3.3	50.9 9.6	55.2 15.1	61.5 26.5	68.9 43.2

Tinted areas: laser-repaired-wafer yields Untinted areas: unrepaired-wafer yields



2. Wafer yield. Repairing wafers that have defects increases the yield, but it will depend on both the clustering coefficient and the product maturity. The separation between the two surfaces is the yield gain, which is greatest with low clustering.

cloud of contaminants in the air or in processing fluids.

The most thorough analysis of random errors on a wafer would involve up to 30 separate calculations of the GNBD, one for each of the yield-sensitive processes used to fabricate a wafer. Each process would have its own defect density, defect-clustering variable, and yield—all of which would contribute to the overall yield because of random defects for the entire wafer.

Because of its complexity, this approach is not used for the following analysis; instead, a single defect density and a single defect-clustering variable are assigned to represent all random defects on a wafer.[3] Although the composite defect density and clustering variables simplify statistical analysis, they are not directly measurable on the wafer.

As the defect density decreases and the amount of clustering increases, the yield of a 1-Mb DRAM for both repaired and unrepaired wafers increases (Table 1), with yield figures expressed as the percent of working 1-Mb DRAM chips per wafer. Several assumptions about the wafer design and production process underlie these yield figures.

The analysis assumes that, except for the early production phase when random defects are densest, the 1-Mb DRAM will have sufficient redundant circuitry so that most chips are repairable. A second assumption is that 80% of the DRAM's area has redundant circuitry available to implement a repair. If a defect falls outside this area, the chip is unrepairable.

Table 1 makes two further assumptions: a yield of 92% in order to account for mask misalignment failures that occur in a 1-Mb-DRAM wafer and a 95% fix-to-attempt yield for the laser-repair process. With this yield, the laser-repair system will repair 95 out of 100 dice that a test system has classified as repairable.

Boosting yields

Following a pattern already observed in the production of 64-K and 256-K DRAMs, laser repair of redundant chips will boost yields most dramatically early in the 1-Mb DRAM's product life, when defects are most numerous. The yield is also improved where defect clustering is low (Fig. 2).

The economic value of laser repair is yield improvement. Because a wide range of defect densities and clustering are included, Fig. 2 also shows yields throughout the product life of the 1-Mb DRAM. Yield improvement of the 1-Mb DRAM, using laser repair, shows a fivefold improvement early in production when defect densities are high and clustering is low (Fig. 3).

The percent of the wafer repaired, like the yield improvement factor, varies with defect density and clustering. It ranges from 10.9% to 41.3% for all densities, assuming moderate to strong clustering (clustering coefficient equals 1.0 to 0.2) (Fig. 4).

Although the impressive yield-improvement statistics provide a sound basis for the efficacy of laser repair when used for the production of 1-Mb DRAMs, redundancy's economic sense is primarily determined by its return on the manufacturer's investment in the laser-repair and memory-test equipment.

Extrapolating current repair times and costs and assuming that anticipated improvements in laser-repair techniques occur, a realistic set of conditions for 1-Mb DRAM production by 1987 can be projected, based on the following assumptions:

Per die:
- Test time per good die: 4 seconds.
- Test time per repairable die: 4 seconds.
- Test time per nonrepairable die: 0.5 seconds.
- Repair time per repairable die: 2 seconds.
- Verify time per repairable die: 1 second.
- Total area of die used for spares and redundant circuitry: 1.5%.

Per wafer:
- Total time needed for wafer load and unload as well

How laser repair works

The major challenge for today's laser-repair systems lies in the scaled-down geometries of 256-K DRAMs. Links on a 256-K chip measure about 2 μm in width, and the centers of adjacent links lie only about 6 μm apart. A 6-μm laser spot size and a maximum beam-positioning error of only ±1.5 μm is essential to ensure that the laser not only finds its small target but also vaporizes it without disturbing neighboring links.

Although semiconductor houses can develop customized interfaces between different models of testers and repair systems, an integrated system such as Teradyne's J386A/M118 Memory Test and Repair System provides the advantages of a common computer, compiler, and programming language. This unified approach dramatically cuts the time needed to develop, debug, and optimize test and repair programs.

With its automatic cassette-to-cassette wafer handling system to minimize contamination, the integrated test and repair system requires operator intervention only to load and unload wafer cassettes. From its cassette, the wafer travels along a conveyer belt to a prealignment station on the wafer handler. After the wafer flat is located, a shuttle arm transfers the wafer to the J386A/M118's step-and-repeat staging area that is controlled by a microprocessor,

as for alignment: 60 seconds.

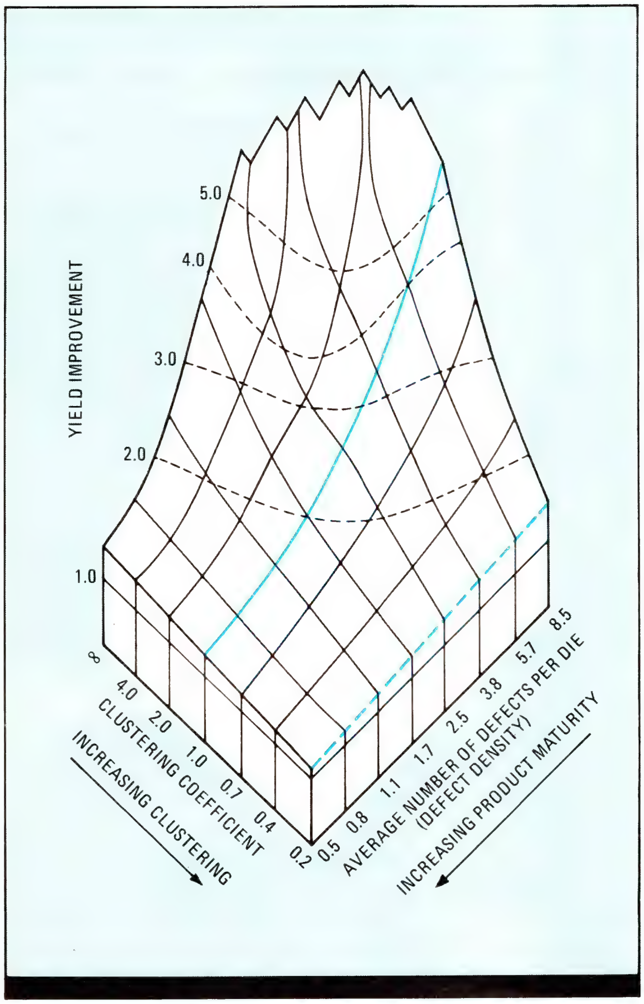
- Number of dice obtained per wafer, based on a 150-mm wafer size: 200.
- Total wafer-processing cost to time of repair: $200.
- Total die index time for entire wafer: 12 seconds.

System and operating parameters:

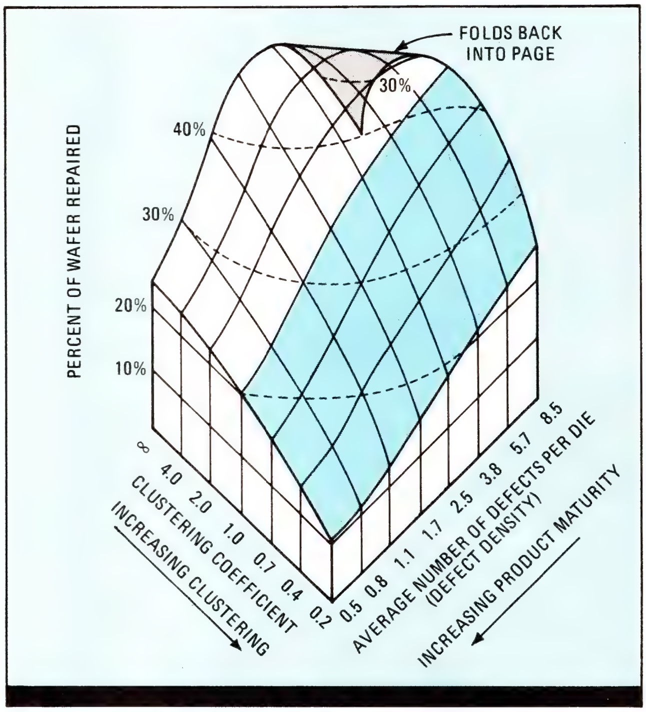
- Cost of test and repair system: $540,000.
- System operating cost: $25 an hour.
- Workweek of 15 shifts at 80% utilization.

The payback, or break-even point, on memory repair can be calculated by comparing the cost of a laser-repair facility with the incremental cost of providing additional front-end capacity. The payback ranges from 14 months for a mature product and process with few defects and strong clustering (defect density equals 0.5 defects per die; clustering coefficient equals 0.2), to less than a month when production is in its early stages, with a large number of defects (defect density equals 8.5; clustering coefficient equals 1.0) (Table 2).

The rapid payback on laser repair early in the production cycle is hardly surprising, because it reflects the



3. Lasers lessen losses. Laser repair of defective memory chips results in significant yield improvement. The yield improvement figures were obtained from Table 1 and were calculated by dividing the repaired yield by the unrepaired yield.



4. Percent repaired. The percentage of the wafer that can be repaired by laser is calculated by subtracting the unrepaired yield from the repaired yield as shown in Table 1. For example, at a coefficient of 1.0 and a density of 0.5, 20% of the wafer can be repaired.

where wafer alignment occurs.

The J386A memory tester then tests the wafer, flagging defective memory circuits die by die and calculating repair instructions for each repairable memory. For each repairable die, the M118 laser repair system completes a final die alignment and uses the memory tester's repair instructions to direct and fire the laser beam at specific polysilicon links.

After link cutting, the J386A tests each repaired chip to determine whether memory repair has been successful (in production, a J386A/M118 achieves a fix-to-attempt ratio of 95% or better). At the completion of the final test sequence, the shuttle arm lifts the wafer back onto the conveyer belt for unloading into a second wafer cassette.

Memories of 1 Mb will place still more stringent demands on the performance of laser repair systems, which will have to maintain a laser-beam spot size of 5 μm or smaller in diameter, and beam-positioning accuracies of ±1 μm or less to handle 1-Mb geometries. The infrared 1.06-μm laser beam that Teradyne's J386A/M118 now uses can be doubled in frequency to produce a visible-light green laser beam that makes possible the smaller spot size. The green laser also does not penetrate as deeply into the wafer as the infrared laser beam does, so the structures beneath the polysilicon links are less likely to be damaged.

fact that working dice are the only items of value obtained from a wafer. Because a laser system can quintuple early production yields, it provides an increase in each wafer's value from a low of $200 before repair to $1,000 after repair. Given a total repair time of under 12 minutes, the repair system's services would be worth $4,000 per hour, considering costs and not revenue.

The payback times in Table 2 assume that the repair equipment is configured so that memory test and laser repair occur in a combined system. The system, though widely used, cannot perform test and repair tasks simultaneously and thus to use the tester and laser to full potential. Because testing takes several times longer than repair, the laser in particular is not used fully.

When test and repair systems are set up in a network, multiple memory testers can operate independently while laser systems repair wafers off line. Thus each can run at full capacity. This approach should be widely used by 1987 and will cut the payback times in Table 2.

Laser-repair payback also is affected by a manufacturers' natural inclination to scale down a chip design that is approaching maturity, not only to increase performance but also to achieve smaller chips and thus more chips per wafer. Therefore, one memory design is unlikely to remain unchanged long enough to reach the 71.6% (unrepaired) yield used to show full product maturity in Table 1.

The yield-boosting potential of the combination of redundant design and memory repair will be realized throughout the market life of the 1-Mb DRAM, both early in production and later on as designs and processes mature to produce the enormous volumes expected in the early 1990s. □

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Donald M. Stewart is marketing manager for the Industrial/Consumer Division, Teradyne Inc., Boston.

TABLE 2: TEST AND REPAIR SYSTEM PAYBACK (YEARS)

Average number of defects per die (defect density)	Clustering coefficient (increasing clustering ⟶)						
	(Poisson distribution) ∞	4.000	2.000	(Price distribution) 1.000	0.700	0.400	0.200
0.500	0.333	0.365	0.397	0.464	0.526	0.690	1.134
0.750	0.198	0.227	0.258	0.321	0.374	0.521	0.925
1.125	0.106	0.131	0.155	0.205	0.248	0.360	0.650
1.688	0.051	0.073	0.095	0.137	0.173	0.268	0.509
2.531	0.020	0.037	0.055	0.091	0.121	0.198	0.394
3.797	0.006	0.017	0.031	0.062	0.088	0.155	0.327
5.695	0.001	0.007	0.017	0.041	0.064	0.121	0.265
8.543	0.000	0.003	0.009	0.028	0.047	0.096	0.223

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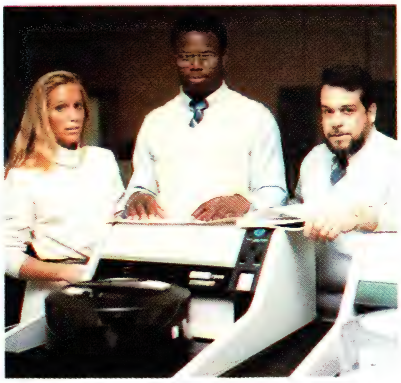
Engineers and scientists who join the Center's laboratories at Newport, Rhode Island and New London, Connecticut, are encouraged to take responsibility almost immediately. They design, develop and test prototypes of these systems and work with private industry on production of the final product.



"I got responsibility right away," says Ronald Jackson, an electronic engineer. "As I showed ability, my responsibility grew. Today, I'm a project engineer." Through NUSC's liberal education policy, Ron has earned a master's since he joined Newport and is working toward a Ph.D.

Because the Center helps its scientists become expert in other fields, electronic engineer Donna Doane is concentrating on computer software. "I'm doing things people never have done before," Donna says. "I design the project, and I see it to the end—to the final product." Monica Sachs is learning something new each day. "I'm working on weapons systems engineering, a broad subject that allows you to get into several different kinds of engineering. I use my electronic engineering background to understand the other disciplines." And Peter Santiago applies his computer background to quality assurance. "I look for self-gratification in the job, and I get that at NUSC."

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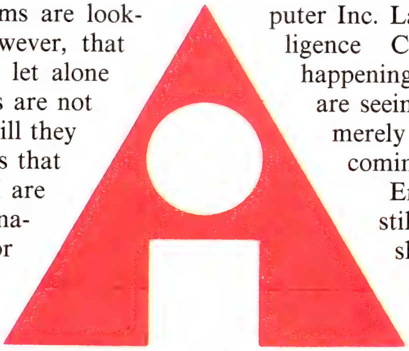
HAS AI's TIME COME AT LAST?

New applications using knowledge-engineering technology are solving problems, but limitations still exist

☐ *by Tom Manuel and Michael B. Rand*

Is artificial intelligence the savior we have all been awaiting to turn millions of computers into truly intelligent assistants and extend man's capabilities far beyond their present limits? Or is it still an elusive El Dorado—a fantastic realm where many explorers and dollars search fruitlessly for mythical gold? As in so much of life, the answer lies somewhere between the extremes.

Today's AI technology will not do all the things that some overenthusiastic supporters have claimed. But at the same time, it is far from useless. The commercial prospects for artificial-intelligence systems are looking good. It should also be noted, however, that computer systems capable of matching, let alone surpassing, human reasoning capabilities are not technologically feasible right now, nor will they be feasible in the near future. Companies that have decided to get their feet wet in AI are finding out that the technology is no panacea. Yet it can be a powerful tool for solving realistic problems. The decision—whether to develop an expert system or replace an existing nonautonomous one—is still a difficult one to make and requires much thought and study.



Many companies as well as the federal government are building or have built in-house expert systems to get firsthand experience about their capabilities and limitations. Such an expert system is a computer system that executes at a high level of performance in a task area that, in humans, would require years of training, education, and experience. Expert systems can streamline labor-intensive processes, thereby increasing productivity and freeing up personnel for other tasks. In addition, they are valuable training aids and a means of preserving expertise. Nowhere is it more evident that realistic problems are being tackled than at the Johnson Space Center of the National Aeronautics and Space Administration, where artificial-intelligence technology is being put to extensive use in the planning and deployment of the manned space station, scheduled for completion in the early 1990s (Fig. 1).

The original idea behind artificial intelligence—the mechanized duplication of human thinking—has given way to the belief that significant amounts of this technology can be and in fact are being transferred to real applications. Applying emerging AI technology to parts of conventional computer applications is an important, growing trend; it helps develop confidence in and gain respectability for applied AI.

"AI is going to be pretty ubiquitous—as graphics is rapidly becoming," says Paul W. Armstrong, artificial-intelligence market segment manager at Apollo Computer Inc. Larry Harris, president of Artificial Intelligence Corp., thinks something similar is happening in the field of natural language. "We are seeing the emergence of natural language as merely a standard feature; this is proof of the coming of age of this technology."

Emerging knowledge-engineering tools are still limited and difficult to use, yet they should not be dismissed out of hand. Nearly all the people who have developed or are currently developing expert systems believe that the new tools coming on the market are useful for small jobs. For example, Se June Hong, a researcher at IBM Corp.'s Thomas J. Watson Research Center in Yorktown Heights, N.Y., and one of the developers of YES/MVS, a real-time expert system for operating mainframe computers running the Multiple Virtual Storage operating system, says that "the trend is to make use of all paradigms in combination. Maturity comes from knowing when to use which techniques for what. No one has the mastery of that yet. That is why the field is so young."

"A lot of stuff that's hard to get around in rule-based expert systems can be handled by an object-oriented approach," says John Clippinger, president of Brattle Research Corp. "There isn't one approach that suits all problems. For example, Prolog [a logic programming language] makes sense in a lot of problems, but it's not for everything."

Managers in many high-technology companies must wonder what they can do to start taking advantage of AI

1. Space station. A conceptual representation of the space station was unveiled at the Johnson Space Center. Expert systems will play a significant role in the design, deployment, and operation of the manned station. At bottom, a space shuttle is docked to the station.

technology. For example, Tony Schofield, manager of strategic planning at Symbolics Inc., advises potential users to look for those areas where good solutions do not currently exist and where the solution should provide considerable value for the expense. Because the current costs of equipment and software are still relatively high, the results must have a tremendous payback. Meanwhile, the costs of AI are coming down fast.

Universities lead the way

Much AI progress has been coming out of major universities. "But they never finish anything at the universities. Therein lies opportunity for commercial companies," observes Larry Geisel, president of the Carnegie Group Inc., Pittsburgh (Fig. 2).

The critical path in AI applications is now the shortage of trained personnel, for the marketplace could support many more specialists than exist at present. According to Geisel, "Many requests for quotes come to CGI that we can't respond to. Lots of them are from the federal government and from nearly every aerospace firm. Many government contracts now specify a requirement for AI content."

Mark S. Fox, head of the Intelligence Systems Laboratory of the Robotics Institute at Carnegie-Mellon University, is also one of the founders of the Carnegie Group. His advice to companies that want to get into AI applications is to pick one of three possible tracks to follow: a slow track, a middle track, or a fast track.

For the slow track, he says, "Send your people to schools for a year or two. Then have them build little systems at first. Company management must face the need and have the ability to wait two to three years on this track. And, yes, also have a consultant to help the people with the little applications." To speed up the process a bit—the middle track—Fox advises companies to "buy a [development] tool and use it within its limitations. The smaller, narrower tools are good for limited problems if you know that the tool and the problems match."

For a fast-track approach, "Hook up with a university or company in a joint-development project. Have their experienced people help your people learn the techniques and build the first system."

Many companies that are in the AI business or are experimenting with the technology have been disappointed by the slow payoff (see related story, p. 28). However, some systems that are based on AI technology or use it are delivering a significant payoff now. The two most notable successes are an expert system and a natural-language interface product.

R1, the expert system, is used regularly by Digital Equipment Corp. to configure all of its minicomputer systems for manufacturing. Intellect, a natural-language front end for data-base management systems, is currently employed at more than 250 sites serving thousands of individual users. Sold by Artificial Intelligence Corp., it is also being offered by many system vendors, including IBM.

Intellect is intended as a very direct use of AI technology—people start using it and should reap benefits very quickly. Two recently introduced versions are even easier for novice users, since the building of application-specific lexicons has been automated.

There are many useful applications for AI across a very broad spectrum of human endeavor, ranging from dieting to manned space stations. Some of the more significant ones exist in the fields of manufacturing, medicine, space flight, business information retrieval, finance, business decision support, publishing, equipment servicing, integrated-circuit design, and oil exploration.

More than 100 applications use AI technology in manufacturing, according to the interim results of a survey currently being conducted by Fox at Carnegie-Mellon. Indeed, this is one of the biggest fields where AI technology is being applied to help solve important problems. Among the best-known expert systems is XCON, alias R1, a program that helps configure Digital Equipment's line of VAX and PDP-11 computers. XCON—derived from "expert configurer"—is used in the company's manufacturing plants worldwide to assure that more than 7,000 products are configured accurately. Although not for sale, XCON's efficient operation has helped maintain DEC's profit margins.

2. August group. The Carnegie Group was started in 1983 to commercialize AI technology. Larry Geisel (center) was hired as president by the company's four founders—(from left to right) Raj Reddy, Jaime Carbonell, Mark Fox, and John McDermott—all AI experts.

Many variations

Because of the number of variations in configuring a VAX system and the inherent complexities in creating optimized computer systems, the configuration problem is anything but straightforward. Basically, XCON receives a purchase order representing a customer's desired computer system. The rule-based program then determines what substitutions or additions must be made to the order to assure the delivery of a consistent, complete, and functional system at the lowest cost.

DEC has used XCON regularly since 1980. The company decided to pursue XCON, explains Arnold Kraft (of DEC's Intelligent Systems Technology Group), because, "The VAX configuration problem couldn't be solved with current technologies, and we knew that because we failed twice trying."

To date, XCON has configured more than 90,000 systems and has an accuracy level of 98%. The fact that XCON does six times as much work as the people who used to have this responsibility at first made workers fear for their job security. Now, they say they feel their jobs have been enriched because the 2% of all orders on which XCON errs represent the most difficult and challenging configuration problems. DEC will not say just how much XCON has saved, but modestly indicates that it has spent millions of dollars to enhance the 4,000-rule system, and adds that XCON has saved the company many millions more.

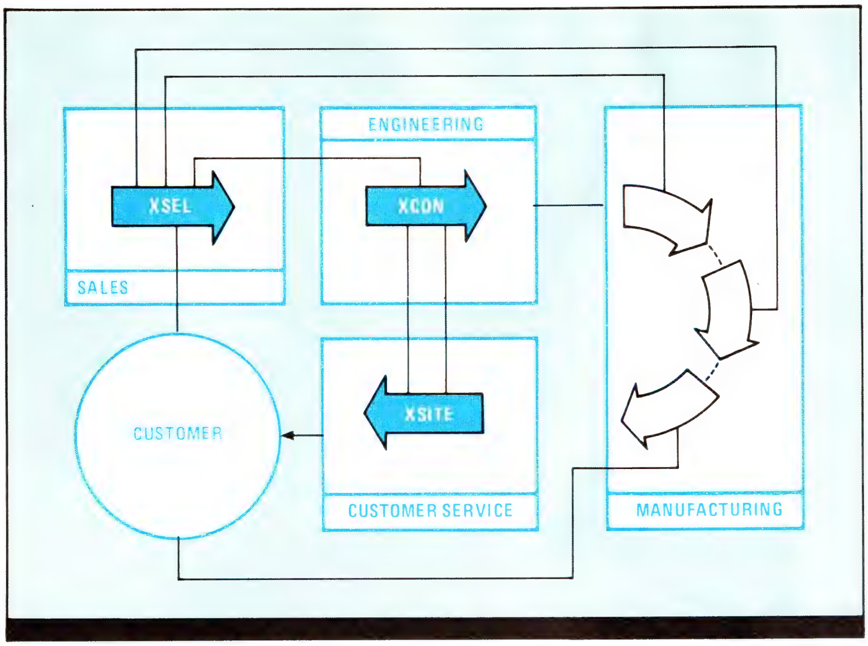
XSEL is another expert system that has proved its worth to Digital. XSEL's job is to help the sales force create accurate and properly defined computer systems for its customers.

The interactive expert sales system uses all of XCON's knowledge. First, the salesperson enters the customer's computer systems requirements. Next, XSEL checks the system for completeness and correctness, suggesting components that might be needed to complete the system if they have been left out. The real clincher is that XSEL fills the order to give the customer the cheapest possible system price.

The last link in the knowledge network, as DEC calls its multiexpert-system network, is Xsite, which optimally lays out the floor space for the computer system's installation (Fig. 3). It even calculates cooling, power, and cable requirements. This automated site-planning system saves the customer's time in preparing the new computer system's site, thus getting the computer up and running more rapidly. In addition, if Digital gets the order right the first time and includes all necessary support equipment, it saves on service calls by technicians and on air freight for missing components.

Officials at DEC claim that the lessons that have been learned along the way are just as important as the financial savings, streamlining of processes, and productivity increases realized through their investment in AI. Kraft's advice to companies thinking about getting involved with expert, or knowledge-base, systems is, "Go slowly at first, and start carefully. Don't pick toy projects; pick strategic ones. An expert system is not a replacement tool; it's a value-added concept to be used where those tools are important."

Concerning the representation of knowledge, Kraft ob-



3. Knowledge network. The coordination of three expert systems into a network has provided an efficient expert cycle that encompasses all areas of the business cycle. They are XSEL, for sales; XCON, an expert configurer of computer systems; and Xsite, a computer-site planner.

serves, "One thing we learned quite early and saw many times is that experts can't tell you what they know in one session or in many sessions." Creating expert systems and learning about the practical utilization of artificial intelligence is an incremental process. There are no real shortcuts, but there are now software packages that allow nonprogrammers and non-AI experts to create expert systems, without having to reinvent the wheel.

HAL, are you there?

NASA is in a unique position to take advantage of the possibilities in such expert systems. The space shuttle program is a success and efforts are being made to make it more practically operational, like an airline. In addition, the space station project is manned and under way. The massive amounts of planning, analysis, and preparation required to coordinate manned space missions create an ideal opportunity for expert systems.

It is therefore no surprise that artificial intelligence has been subjected to considerable study and development at Houston's Johnson Space Center, under the auspices of the Technology Development and Applications Branch. Robert Brown (Fig. 4), its chief, is excited about his recent work in expert systems. "We are on the threshold of a new era; the concept of the fifth-generation computer is based on artificial intelligence," he says. The artificial-intelligence section of Brown's division has nine prototype expert systems at work and four more expert systems planned.

Robert Savely, head of the AI group, explains that his department "will be used as a technology-transfer section, with the job of transferring artificial-intelligence technology from the academic and industrial arena to the mission-planning and -analysis division." In the future, the AI group will develop expert systems for other departments at the Johnson center, but for now it is now busy working on the present projects.

The most mature expert system is called Navex, which will operate the high-speed ground navigation console at the Johnson Space Center's Mission Control Center during space shuttle takeoffs and landings (Fig. 5). Along with one human high-speed navigation expert, Navex will displace the current console procedure involving three humans. As soon as the system is connected by fiber-optic link to the control center, Navex will be tested (in parallel with the usual method) during the next available space shuttle flight.

Phase One implementation of the Navex project covers the shuttle entry phase, which begins at about 180,000 ft, after the space shuttle has left its orbit. When the shuttle emerges from radio blackout, a hectic process begins to calculate precisely where it is and to update onboard computers, readying it for landing. Time is critical in this phase. The job of the expert system is to control and monitor the Kalman filter process, which tracks radar data used to estimate the current shuttle state vector. The state vector indicates the current shuttle position, velocity, and acceleration (Fig. 6).

Another expert-system prototype nearing completion is the Flight Design System Executive, an intelligent front end to the Flight Design System. It will help a casual user familiar with the design system's capabilities to access the processors without a detailed knowledge of the system's executive. The Flight Design System determines the space shuttle's trajectory profile from the point where the shuttle reaches its orbit to the point where its orbit changes in preparation for re-entry into the Earth's atmosphere. Up to now, human experts with detailed knowledge of the executive system represented the only means of designing the trajectory and linking the processors that are required to generate information pertinent to a shuttle flight.

Software still useful

The mission planning and analysis division has 3 million lines of undocumented software code used for space missions. The code exists in the form of subroutines that require timely and intricate manipulation to generate the necessary interface and sequence tables for planning a shuttle flight.

Part of the benefit of expert-system technology is organization, which the Johnson Space Center says is a crucial need. The software routines written during the past 20 years are still useful; in fact, only 10% of the code for the space station project will be new.

The Automated Software Development and Verification expert system will manage these millions of lines of code. It will contain the software's master data base and give the user an interface for putting together the code for new applications. "There is very little code we don't have; the problem is just putting it together," Brown admits. The most limiting resource on the space shuttle is crew time, and the same is true on the ground. Expert systems can free highly trained personnel from console and computer jobs and give them time to use the ultimate, irreplaceable human attribute: creativity.

An example of NASA's push for this creative concept is the development of an interactive graphics expert system with which nonprogramming engineers and managers can design graphic simulations for terminals. Usually, this would take expert programmers months to accomplish. For example, preparing the color simulations for the Mars return mission to collect samples from the Martian surface with an unmanned intelligent rover and return them to Earth, is an extremely time-consuming and arduous task (Fig. 7). Simulations for the space station's operational details have been under construction for much longer and are still not complete.

Power scheduling

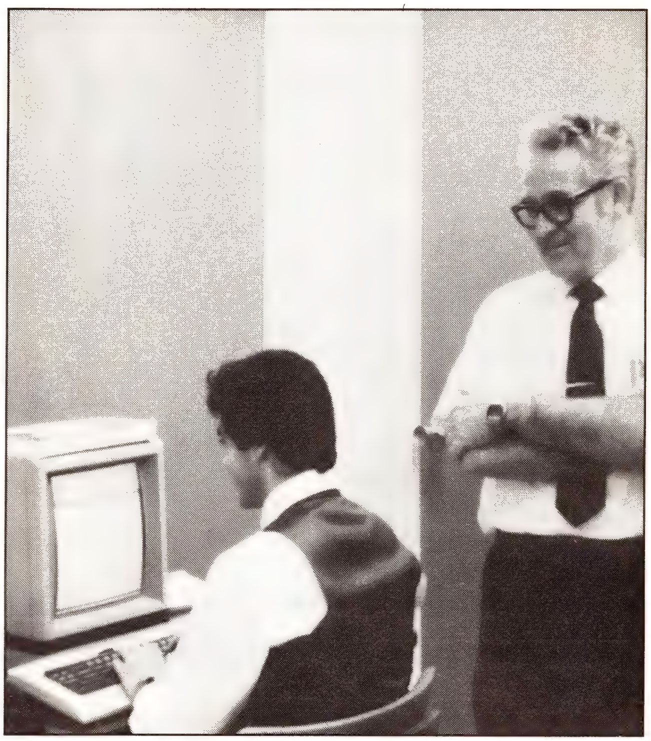
The process monitoring and control expert system, called Exeps, will intelligently assist a human electrical expert in scheduling the power needs of a shuttle mission. At present, this job takes an expert analyst about four days of planning, and a lesser expert up to two weeks to implement. The rules of the job are not well documented; they are highly evolutionary. In addition, no scheme for translating the rules into software exists. The expert system will be used to determine the exact number of fuel cells a specific mission requires.

NASA is also working on an expert system to aid in monitoring Mission Operations Center software status. Currently, a printer-controller visually examines the online printer as it prints status and error messages. The controller primarily reports status information to the computer supervisor in the control center. It will give the computer supervisor status information during initialization and all restart activities. The system will also ask the supervisor for information as it is needed and will analyze, recognize, and report advisories back.

Savely offers another reason for getting involved with AI (Fig. 8). "We are looking at expert systems for more than just a reduction of personnel and hardware costs—namely, for performance improvement, training, and the preservation of expertise," he says. Most of the engineers and scientists at the Johnson Space Center have 20 to 25 years' worth of experience. That is an abundance of knowledge that NASA does not want to lose when they leave or retire. Expert systems will be able to preserve this invaluable expertise and make it available to NASA's new staff. Such systems will be valuable training aids as well.

Boeing Aerospace Co., a contractor for the space station, has developed Ecesis (for Environmental Control Expert System In Space), a prototype expert system for autonomous control of a regenerative environmental-control and life-support subsystem on board a manned space station. This system recycles the waste products the crew generates. Given the high cost of labor on manned space stations, a constant aim for space exploration projects is making autonomous all processes that distract the crew from concentrating on mission objectives.

Capitalizing on the fact that there are about 40,000 companies using DEC's VAX computers, General Research Corp. has developed TIMM/Tuner, a VAX/VMS system-tuning expert. Tuning an operating system is the process of optimizing it for maximum performance. Because the tuning of a computer's operating system depends on the computer's configuration and the types of programs it is executing, this tuning process is time consuming and complicated. TIMM/Tuner was developed to aid VAX system managers whose responsibility is to adjust the system's performance when necessary.


4. New era. Robert Brown, NASA chief of technology development, is excited these days. The work that expert systems and AI technology have engendered has helped his division attract talented engineers and computer scientists to complement his experienced staff.

Designed for nonprogrammers

TIMM/Tuner was developed on TIMM (The Intelligent Machine Model), a software product that is an expert-system development tool. Unlike some other expert-system development tools, TIMM is designed for use by managers or other nonprogrammers, so they can introduce artificial intelligence into their companies without a large investment in personnel, equipment, or training. The system, though easy to use, is nonetheless a powerful development tool for the AI expert, or knowledge engineer. The software runs on many popular computers, as well as more specialized systems that are geared toward AI.

Another expert-system development tool is ART, for Automated Reasoning Tool (Fig. 9). It uses an inference engine and, in combination with a selection of different knowledge bases, is capable of constructing a wide variety of expert systems. An inference engine is a system that can derive or deduce new facts about a particular situation from pieces of knowledge that have been explicitly stored. The Johnson Space Center chose ART for developing expert systems. ART was created by Inference Corp., which also helped the space agency develop

5. Mission control. This high-speed ground navigation console now requires three people per shift for real-time support during launch and landing of shuttle missions and simulations. When Navex is implemented, one person and a navigation expert system will support the same function.

Navex, its first expert-system prototype.

As powerful and indispensable as ART is to NASA, the agency is looking forward to third-generation expert-system-building tools. This generation will be easier for first-line managers and engineers to use. The tools will have a built-in knowledge-engineering capability so that the interface between user and expert system will be less restrictive.

Elsewhere, with all the technological strides being made in telecommunications, an expert system for telephone-cable analysis was a natural project for AT&T Bell Laboratories. AT&T Communications and other companies of the telephone system are using ACE (for Automated Cable Expertise) to diagnose problems in their telephone networks and determine the appropriate kind of maintenance or corrective action. Because maintaining and supervising millions of miles of telephone lines is a complex undertaking, ACE examines each day's cable reports overnight and by morning has diagnosed specific cable trouble spots for maintenance specialists and suggests which repairs are needed. This leaves the human specialists more time to concentrate their efforts on preventive maintenance planning.

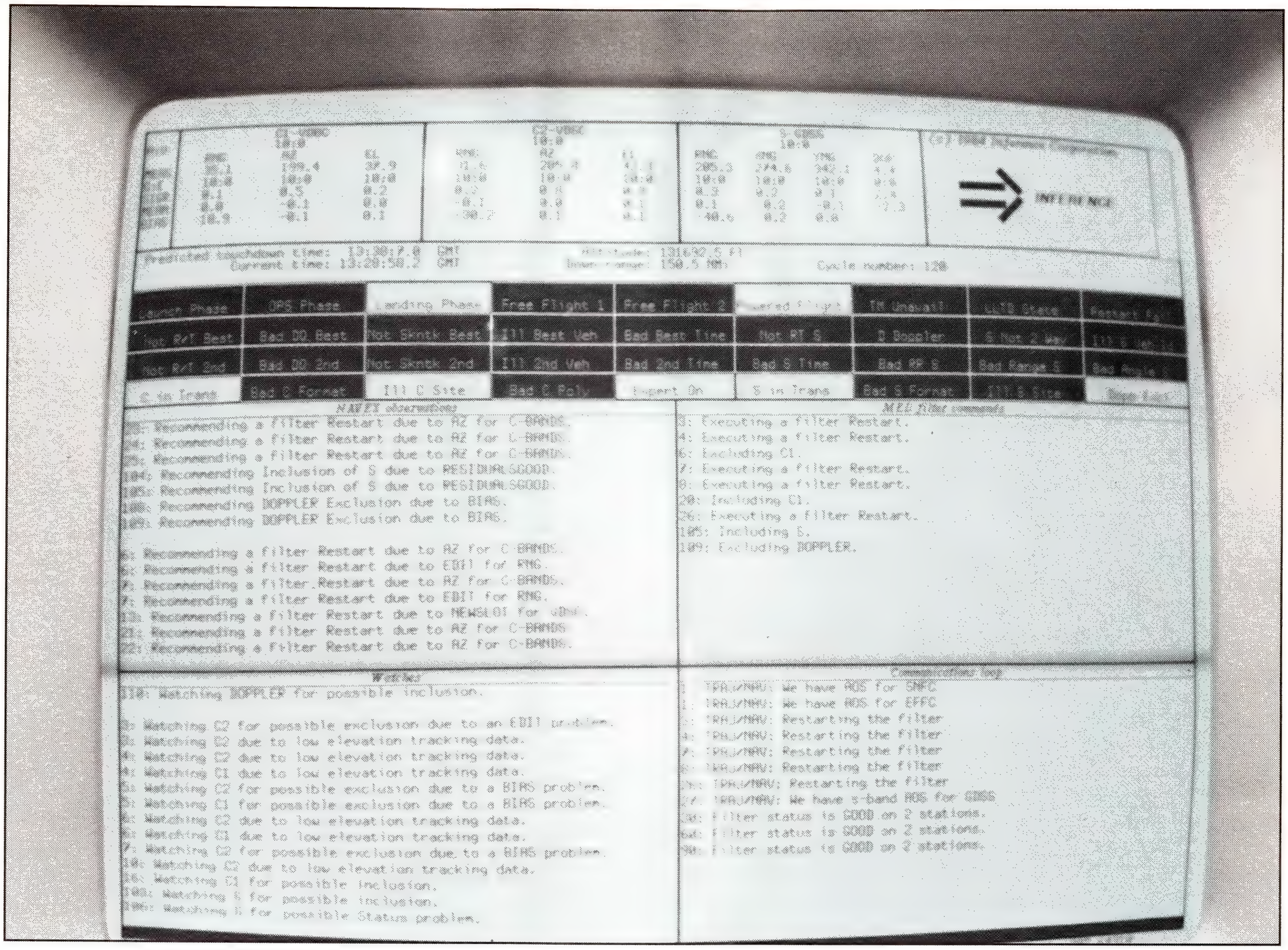
With ACE, what previously took a week for Southwestern Bell's human analysts can now be accomplished in about an hour for a city the size of Fort Worth, Texas. Originally, Southwestern Bell was a test site for ACE. It was so popular and productive that Southwestern Bell is still using the system two years later, and three ACE systems are scheduled for testing at two other telephone companies this month. During the trial, each company will assess ACE's impact on its operations. The trial will last about half a year, and ACE is expected to be available for purchase in the latter half of 1985, according to sources at Bell Labs.

Trouble is their business

Another fertile territory is the railroad, where revenues are projected to increase by 9% in 1985 as the U.S. works to revitalize its rail system. The trains are running and General Electric wants to hop a ride.

In 1983, GE announced a computerized troubleshooting system that promised to help novice mechanics analyze and repair complicated diesel-electric locomotives. After experiencing some initial trouble with the hardware for the first prototype expert-system troubleshooter, the company now has the Delta (for Diesel-Electric Locomotive Troubleshooting Aid) expert system, being field-tested in two locations: Burlington-Northern and Union-Pacific railroads, both in Nebraska. The expert system uses production rules and an inference engine to diagnose locomotive problems and suggests repair procedures to mechanics.

Another item in the category of fault isolation and



```
Predicted touchdown time: 13:30:7.0  GMT        Altitude: 131692.5 Ft
        Current time: 13:20:50.2  GMT       Down range: 150.5 NM        Cycle number: 120
```

```
                NAVEX observations
[illegible]: Recommending a filter Restart due to AZ for C-BANDS.
[illegible]: Recommending a filter Restart due to AZ for C-BANDS.
[illegible]: Recommending a filter Restart due to AZ for C-BANDS.
104: Recommending Inclusion of S due to RESIDUALSGOOD.
105: Recommending Inclusion of S due to RESIDUALSGOOD.
108: Recommending DOPPLER Exclusion due to BIAS.
109: Recommending DOPPLER Exclusion due to BIAS.

[illegible]: Recommending a filter Restart due to AZ for C-BANDS.
6: Recommending a filter Restart due to EDIT for RNG.
[illegible]: Recommending a filter Restart due to AZ for C-BANDS.
7: Recommending a filter Restart due to EDIT for RNG.
13: Recommending a filter Restart due to NEWSLOT for [illegible].
21: Recommending a filter Restart due to AZ for C-BANDS
22: Recommending a filter Restart due to AZ for C-BANDS.
```

```
                MCC filter commands
3: Executing a filter Restart.
4: Executing a filter Restart.
6: Excluding C1.
7: Executing a filter Restart.
8: Executing a filter Restart.
20: Including C1.
26: Executing a filter Restart.
105: Including S.
109: Excluding DOPPLER.
```

```
                Watches
110: Watching DOPPLER for possible inclusion.

3: Watching C2 for possible exclusion due to an EDIT problem.
[illegible]: Watching C2 due to low elevation tracking data.
4: Watching C2 due to low elevation tracking data.
4: Watching C1 due to low elevation tracking data.
5: Watching C2 for possible exclusion due to a BIAS problem.
5: Watching C1 for possible exclusion due to a BIAS problem.
6: Watching C2 due to low elevation tracking data.
6: Watching C1 due to low elevation tracking data.
7: Watching C2 for possible exclusion due to a BIAS problem.
10: Watching C2 due to low elevation tracking data.
26: Watching C1 for possible inclusion.
103: Watching S for possible inclusion.
106: Watching S for possible Status problem.
```

```
                Communications loop
1: TRAJ/NAV: We have AOS for SNFC
1: TRAJ/NAV: We have AOS for EFFC
3: TRAJ/NAV: Restarting the filter
4: TRAJ/NAV: Restarting the filter
7: TRAJ/NAV: Restarting the filter
8: TRAJ/NAV: Restarting the filter
26: TRAJ/NAV: Restarting the filter
27: TRAJ/NAV: We have s-band AOS for GDSS
30: Filter status is GOOD on 2 stations.
60: Filter status is GOOD on 2 stations.
90: Filter status is GOOD on 2 stations.
```

6. Navex. This Lisp machine is running the Navex system with data from a shuttle flight. Data from one to three radar stations is processed through a filter. The four quadrants indicated compare decisions the expert system and its human counterpart made about the flight.

diagnosis is an expert system from the automated-test-equipment industry. Forest is a system developed at Bell Labs that attempts to solve the 5% of problems that current ATE systems usually cannot unravel without considerable human effort. The two most serious problems Forest was designed to solve are multiple faults and problems caused by components or systems that gradually drift out of calibration.

Robot mathematicians

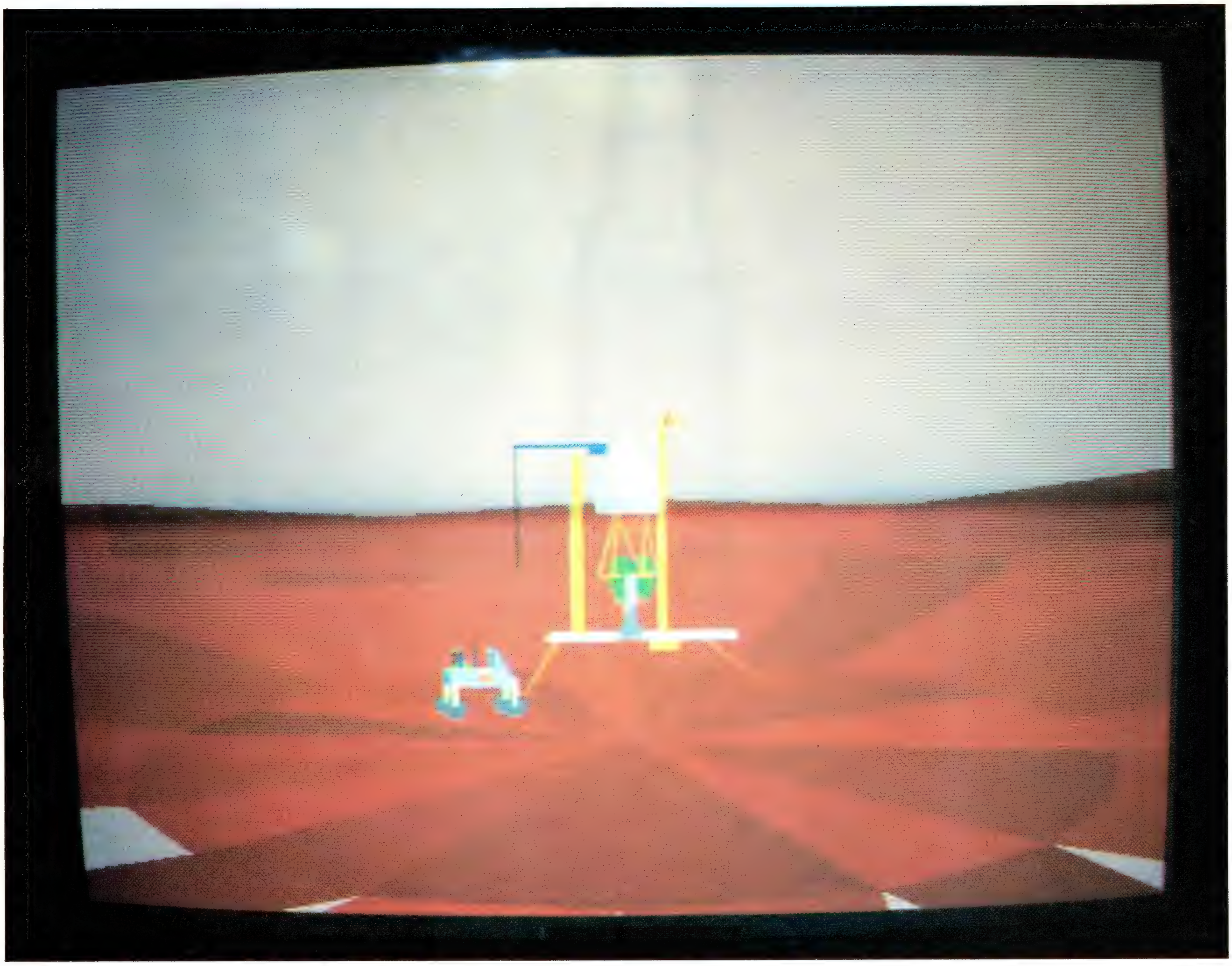
Mathematics is probably the most powerful tool used in science and engineering. Macsyma is an extremely large interactive computer program devoted to manipulating algebraic expressions in order to solve mathematical problems. Written in Lisp, Macsyma (derived from Project MAC's Symbolic Manipulation system, named after the first computer science laboratory at the Massachusetts Institute of Technology) has been under continuous development since 1969, making it the oldest expert system. It represents more than 100 man-years of software design and programming effort and comprises more than 300,000 lines of Lisp code.

In 1982, Symbolics Inc. received exclusive marketing rights to Macsyma. There are currently between 2,000 and 4,000 users worldwide. According to Richard Pavelle, Macsyma product manager at Symbolics, "10% of the people who use Macsyma use it six to eight hours per day, 40% use it one to two hours per day, and the rest use it casually. For many people, it's simply indispensable," he adds. When Pavelle first started working with this expert system, he was skeptical about its capabilities. However, after seeing it compute the components of the Einstein tensor for a symmetric metric in 15 min of real time—a calculation that ordinarily takes a human expert mathematician several hours to compute—Pavelle was a believer.

REX, for Regression Expert, was Bell Labs' attempt to produce an expert system that made advanced statistical techniques available to novices. The motivation to develop this system came from the fact that existing statistical software requires considerable knowledge of statistics to be used effectively. REX never made it to the prototype stage, but engendered a new, more pervasive, expert system called Student. This new system allows statisticians in a variety of disciplines to build expert systems that will be user-friendly for those disciplines.

Computer-aided design tools, in the form of work stations and advances in integrated-circuit fabrication technology, have helped fuel the boom in IC design, particularly in very large-scale ICs. What's more, with the integration of an expert system in the VLSI design process, the circuit designs are now plagued by less uncertainty and are produced more quickly.

The Design Automation Assistant, or DAA, is an



7. Mars lander. Color simulations of the Mars sample return mission represent many man-hours of programming effort. An expert-system front end will enable nonprogrammers to generate simulations without the high-powered programming skills now required.

expert system developed jointly at Carnegie-Mellon and Bell Labs to aid designers of VLSI circuits. DAA allows designers to develop an algorithmic or high-level description of the system on the chip. Then, by interacting with the expert system, the designer can add the details required to turn out a complete design.

DAA uses a designer's description of the chip's requirements as input and produces a symbolic state-machine diagram and net list of the modules. The finite state-machine representation describes which architectural modules are needed for a VLSI chip and what they do. The net list provides the module interconnection list.

At this point, DAA can be of no further assistance. Still left to be done is translating this design level into an actual digital logic diagram and the generation of the geometric layout. Generally, this is accomplished with another computer program, completely separate from DAA. The last level of design involves producing the mask used to fabricate the chip at the foundry.

It is evident that this expert system cannot take a designer through the whole process. From DAA's ability to coordinate the communication throughout the layers of the design process, multilevel documentation is automatically provided, and the final designs are typically more testable and reliable. The process of creating a design with DAA or any other expert IC designer still requires a lot of human interaction, although compared with the usual graphical method using a work station, the life-cycle cost of creating a VLSI chip is low.

Thinking Machines Inc. is currently marketing an advanced VLSI system that gives the designer the option of intervening at any point along the design process. The system has the ability to take the designer from behavioral representation to layout but requires considerable human interaction. This design package currently runs only on Lisp machines and requires a minimal knowledge of the computer language.

Raising expectations

While aggressively exploring the frontiers of AI, Thinking Machines' approach to marketing has been conservative; in fact, the company is reluctant to call the package an expert system. "We want to raise the expectations about expert systems, but not too much," says Rolf Fiebrich, senior scientist at Thinking Machines.

Fiebrich claims that, "Compared with what other companies are offering, our advanced VLSI design system can significantly reduce design time and give the most flexibility from start to finish." He adds that when the design tool does get expert capabilities integrated into the system, it will let the designer intervene less often in the process, thereby increasing the speed of the whole procedure. As it stands, the system offered will do the complete job.

Another company offering a VLSI development system that takes a designer from a behavioral description to mask is Metalogic Inc. Jay Southard explains, "We do use Lisp and Lisp machines but our VLSI system has no AI." He goes on to say that people should realize the powerful environment and capabilities inherent in the Lisp programming language. It isn't necessary to use AI techniques to use a Lisp machine.

Navigation is a part of the Pilot's Associate concept, a key area identified in the Defense Advanced Research Projects Agency's Strategic Computing Program. The Pilot's Associate will include additional functions, such as flight control, threat management, and tactics. The expert system for navigation will interface with expert systems cognizant of other functions. This concept of a local-area network of expert systems under an executive expert system is a theme that NASA is also stressing for its space station.

8. Head of AI. Robert T. Savely, head of the AI group at Johnson Space Center, believes that his group will eventually act as a technology-transfer section. Savely's department will provide expertise in AI and work with other teams at NASA to help distribute the powerful technology.

To help the military organize the loading of transport planes, the Advanced Information Technology Applications Department of SRI International has developed an expert system called the Automated Air Loading Planning System, or Aalps.

"Aalps is a system of spatial reasoning," points out Gregory Stachnick, senior computer scientist for SRI. "The job was normally done by skilled personnel who could allow for last-minute changes in equipment, aircraft, etc., and still keep the planes balanced," he adds. This process of balancing the payload is important for the plane's fuel economy and responsiveness. "It was a job with rapidly changing ground rules, and normally done by hand," Stachnick says. "The people who did it were very good at loading planes but not so good at explaining how they did it."

Always wins the bake-off

The system is now operational and has some 300 users—among them the U.S Army—which perform 1,000 loadings a month. Manually, the loading process used to take many hours; Aalps can do the layout in a couple of minutes or less, which permits "what if" analysis. How good is it? "As good as a human, but faster. We've had many bake-offs, and we are always as good as or better than humans," claims Stachnick.

Because of its certification and validation as a reliable and useful tool, Aalps has been named the Army's official plane-loading system. It is in use at several installations, including the 82nd Airborne Division, in North Carolina; at Fort Bragg, in California; Fort Lewis, in Washington; Fort Leavenworth, in Kansas; the 101st Airborne Division, at Fort Campbell, Ky.; and the DOD Center for Logistics, at Fort Lee, Va.

Artificial intelligence is also beginning to find applications in the field of medicine, where physicians have long relied on their own knowledge for diagnosing diseases and suggesting treatements. Medicomp of VA Inc., in Fairfax, Va., markets a computerized diagnostics associate for physicians. With a large knowledge base of medical facts on more than 2,000 diseases in every category of internal medicine, about 800 symptoms, 2,200 physical findings, 700 clinical tests, and 1,100 generic drugs, Medicomp is an efficient assistant. Besides allowing a doctor and a nurse or assistant to handle nearly the whole workload of two physicians, Medicomp helps get patient histories, reduces paperwork by one third, and almost eliminates the space needed for patient files.

Medicomp is available as an on-line service or as a stand-alone system. Implemented on an IBM Series 1 computer, this computerized medical assistant can take complete medical histories from new patients, maintain histories after follow-up visits, and automatically perform diagnosis-driven history updates.

After the patient record has been entered or updated, the system produces a workup checklist—a ranked listing of the diseases most closely matching the patient's symptoms. From this, the physician selects the diseases to follow up. Based upon the physician's selection of possible diseases, the program generates a list of additional tests to have performed, lists their costs, and prints physical findings as well as historical items for the diseases selected (see "The computerized medical assistant helps with a critical diagnosis," p. 60).

The Medicomp system uses both a knowledge base and a relational data base side by side. The data base helps recognize symptoms and findings linked in many combinations—useful for distinguishing between acute and chronic conditions, for example. "Sometimes it triggers on one base or the other, sometimes both," says Peter Goltra, Medicomp's president. Currently, according to Goltra, Medicomp has 40 to 50 regular users calling the system from across the nation. Each user makes a consultation on an average of once a week. Doctors prefer it for their difficult and puzzling cases.

The computerized medical assistant helps with a critical diagnosis

One day, 14-year old Bob Harris (a fictional case from a composite of actual situations) began complaining of a sore throat. The next evening, he developed a headache, and the following day he seemed very irritable. That night, Bob awakened with a fever and in the morning complained that bright light bothered his eyes.

Bob had never had any serious medical problems and had been well all winter. His mother brought him to see Dr. Raymond Wilson, at the Lakeville Clinic. Dr. Wilson found that Bob had a fever of 103.6°, a rapid pulse of 120 beats/min, and a red throat, but no swollen nodes. He also thought Bob seemed a bit lethargic. This information was entered into Bob's patient record in the Medicomp system (printout 1).

Dr. Wilson's preliminary diagnosis was a viral upper-respiratory infection, most likely the flu. A year ago, he would probably have sent Bob home with instructions to take acetaminophen, drink plenty of fluids, and get some rest. But the Lakeville Clinic had Medicomp available. So before sending Bob home, Dr. Wilson went to his terminal and asked for a consulation. In less than a minute, the computer displayed a differential diagnosis based on its

PRINTOUT 1

```
                                   Medicomp Medical Record System              PAGE   1
PATIENT 254-62-216W                       PATIENT RECORD                  1 / 12 / 85    15:51:37
Bob Harris — 14-YEAR-OLD CAUCASIAN MALE Student

CHIEF COMPLAINT: Headache and sore throat

SYMPTOMS                                                                  ONSET        DURATION

JOHN     1 / 12 / 85     Fever                                            1 / 12 / 1985
                         Headache pain                                    1 / 10 / 1985
                              which has started recently                  1 / 10 / 1985
                         Other eye symptoms —                             1 / 12 / 1985
                              Sensitivity to light (photophobia)          1 / 12 / 1985
                         Sore throat                                      1 / 09 / 1985
                         Highly irritable                                 1 / 11 / 1985

OTHER HISTORY

                         Previously well
                         Symptoms started where local season is
                              Winter

PHYSICAL FINDINGS

                         Temperature 103.6                                1 / 12 / 1985
                              Fever 103.6                                 1 / 12 / 1985
                         Pulse Rate 120                                   1 / 12 / 1985
                              Tachycardia 120                             1 / 12 / 1985
                         Oral Cavity                                      1 / 12 / 1985
                              Pharynx                                     1 / 12 / 1985
                                   Mucosa, red                            1 / 12 / 1985
                         Level of Consciousness                           1 / 12 / 1985
                              Lethargy                                    1 / 12 / 1985

PERTINENT NEGATIVES

                         Lymph Nodes
                              NO Enlarged cervical (cm.)                  1 / 12 / 1985
DOCTOR'S COMMENTS

JOHN     1 / 12 / 85     Viral upper-respiratory infection. Symptomatic treatment:
                              Acetaminophen, fluids, bed rest
```

Most AI systems are geared for small groups of specialists in a professional field. There is, however, an AI application targeted at some 80 million people: those who are overweight. This personal expert system for off-the-shelf sale made its debut last month at the Winter Consumer Electronics Show in Las Vegas. Called the Original Boston Computer Diet, it is being marketed by Scarborough Systems Inc. and serves as a personal weight-loss counselor for anyone with access to an IBM (or compatible) Personal Computer with at least 128-K

analysis of the symptoms and findings. The list of possible diagnoses was ranked in descending order of likelihood (printout 2).

What Dr. Wilson saw surprised him. The leading diagnosis, influenza, agreed with his own. However, the second diagnosis, meningococcal meningitis, alerted him to the possibility that the boy might be in the early stages of a potentially fatal illness. He then asked the computer for a workup on meningococcal meningitis.

A few seconds later, the computer listed all the tests that would confirm or rule out that disease (printout 3). Each one was weighed for its importance in the diagnosis. The computer also showed each test's approximate cost. Dr. Wilson typed CSF, for cerebral spinal fluid, to order several tests that he would have performed on a sample of Bob's spinal fluid. Ten minutes later, he observed gram negative cocci bacteria in the sample and immediately sent Bob to the hospital, where he was started on a high dose of intravenous penicillin. The next day, as the remaining tests came back—confirming the diagnosis of meningococcal meningitis—Bob was feeling much better. He went on to make a complete recovery.

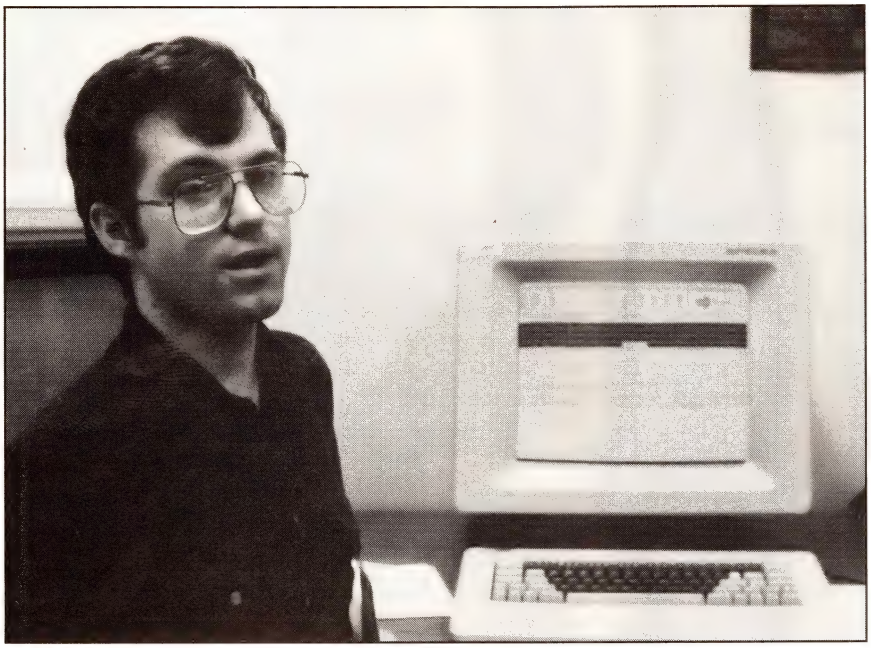
PRINTOUT 2

```
                                Medicomp Medical Record System          PAGE      1
PATIENT  254-62-216W          DISEASES IN ORDER OF LIKELIHOOD     1 / 12 / 85   15:55:23
     Bob Harris — 14-YEAR-OLD CAUCASIAN MALE Student
DESCRIPTION:                                                                    WGT
INFLUENZA                                                                        13
MENINGITIS MENINGOCOCCAL                                                         10
MENINGITIS BACTERIAL                                                             10
COMMON COLD                                                                       9
MYCOPLASMA PNEUMONIA (PRIMARY ATYPICAL)                                           9
MENINGITIS ASEPTIC                                                                9
REYE'S SYNDROME                                                                   9
RUPTURED CEREBRAL ANEURYSM                                                        8
HERPES SIMPLEX MENINGOENCEPHALITIS                                                8
```

PRINTOUT 3

```
                                Medicomp Medical Record System               PAGE     1
PATIENT 254-62-216W                 WORKUP WORKSHEET               1 / 12 / 85   15:57:23
Bob Harris — 14-YEAR-OLD CAUCASIAN MALE Student
     WORKUP FOR MENINGITIS MENINGOCOCCAL
DIFFERENTIATING TESTS                                                     COST   WGT
     Blood Parameters
          CBC—                                                            9.00     1
               Leukocytes                                                 4.50     7
                    Segmented Neutrophils                                          3

     Cerebrospinal Fluid (CSF)                                                     4
          Opening Pressure                                                         7
          Cells
               WBC                                                                16
                    % Lymphocytes + Monocytes                                     12
                    % Neutrophils                                                  8
          Protein                                                         7.00    15
          Glucose                                                         5.00    10
          VDRL                                                                   (—)
MICROBIOLOGY
     Cerebral Spinal Fluid Gram stain (—) Cocci Neisseria meningitidis             7
     Blood Culture Neisseria meningitidis                                          7
     Nasopharyngeal Culture Neisseria meningitidis                                 1
     Cerebral Spinal Fluid Culture Neisseria meningitidis                         22
```



9. Works of ART. Chris J. Culvert and ART (for automated reasoning tool) are old pals. With a knowledge engineer from Inference Corp. (developers of ART), Culvert used ART to develop Navex. ART has proved its aptitude for helping to develop expert systems.

of memory. It is soon to be available for Apple II and Commodore 64 personal computers.

The expert system develops an individualized diet for one user—and only one, because it keeps an ongoing personal weight-loss, diet, and fitness history—by analyzing personal facts, such as weight, height, and eating habits. This information is combined with data from a knowledge base of psychological traits, nutrition standards, fitness knowledge, and the caloric and nutritional values of more than 700 food items, to which the user can add further entries.

The system not only produces personalized diets and fitness programs but also monitors the results and motivates users to continue dieting and to modify their behavior to maintain the desired weight and fitness level. The program has two psychological components. The first looks at the moods, habits, and personality of the user to help develop the most suitable diet and fitness program. The second is the presence of three separate computer counselors—called Amy, George, and Shirley—with different personalities, so the user can select the counselor he or she likes most.

The natural way

Natural-language systems, of which Intellect is the granddaddy, are showing up in greater numbers. One such system, though still in the research phase, resides at IBM's Thomas J. Watson Research Center. Called TQA, it currently understands questions in English and translates them into the structured query language, SQL, used in IBM mainframe computer systems.

The system uses a knowledge base consisting of a dictionary as well as grammar and semantic rules. (Natural-language systems are really expert systems in disguise, and the knowledge base is the English language.) In addition, there is code for looking up words in the dictionary, for parsing questions using the rules of grammar, and for undertaking semantic interpretations with the semantic rule base.

"One difficulty in AI applications is in generalizing systems," according to Warren Plath, a TQA researcher. The TQA team is now working to make TQA easily adaptable to different data bases and even different data-base management systems. The goal is to be able to make these shifts without getting the linguists heavily involved.

Meanwhile, Symantec, which last year promised a natural-language interface for IBM Personal Computers, has apparently put that project on the back burner after merging with C&E Software. At this time, it is concentrating on software tools for the IBM PC, but the company is not willing to discuss product plans. Reportedly, the natural-language product, written in the P-system, was too slow to make it to market.

AI technology is also being applied to word processors. At IBM's Thomas J. Watson Research Center, a project called Epistle has the primary goal of bringing intelligence to word processing.

The first prototype to come out of the Epistle project was developed for critiquing text. Now IBM is applying its technology base to a number of linguistic applications, among them language translation and the teaching of grammar, structures, and syntax. One of the tasks under way is that of mechanizing the translation of IBM's documentation into foreign languages.

Lance Miller, who has been heading up the Epistle project for about four years, says that Epistle will not try to translate everything, only difficult passages too problematic for human translators. The research team has tested Epistle's current functions at the lab and hopes to get it out into a field test this year, he says. However, he is quick to emphasize that Epistle is just an experimental prototype, not a product.

Epistle is also being used to develop an on-line dictionary with a twist—reversing the order of things. Called Wordsmith, this will be a word-finding dictionary similar to a thesaurus. The user will be able to describe several characteristics of a word or words, and the system will return a selection of words meeting these criteria. Then the user can select one of those words as the focus, ask for a definition, and then make one of the words in the definition the next focus, and so on. It has been implemented with 130,000 words, claims Miller. He suggests that giving it to children would encourage them to become more interested in writing, providing basic training in words and their associations.

Another research goal is re-implementing all of Epistle in Prolog, with additional semantics. Prolog is good for semantic analysis, says Miller. He also predicts that the Prolog version could probably run on an IBM PC AT, and he is very interested in seeing it run on the IBM PC and its compatibles. □

DOD VEXES IC MAKERS

The Defense Department's outdated bidding regulations bar manufacturers from contributing expertise to the process

☐ *by Ed Macaruso*

It's time for the Department of Defense to reevaluate the way it acquires integrated circuits for use in crucial military systems. Today's modern military electronics system needs fewer components, now that many ICs contain more than 100,000 individual transistors, with million-transistor memory chips and more complex logic just around the corner.

Yesterday's 60-lb bombing or navigation computer or 30-lb very-high-frequency radio is now on a single printed-circuit board weighing a few ounces. Yesterday's integrated circuit is today's system in silicon. This is the system that flies the aircraft, directs the fire-control system, detects and counters threats in the electromagnetic spectrum, guides the missile, and detonates the armed warhead.

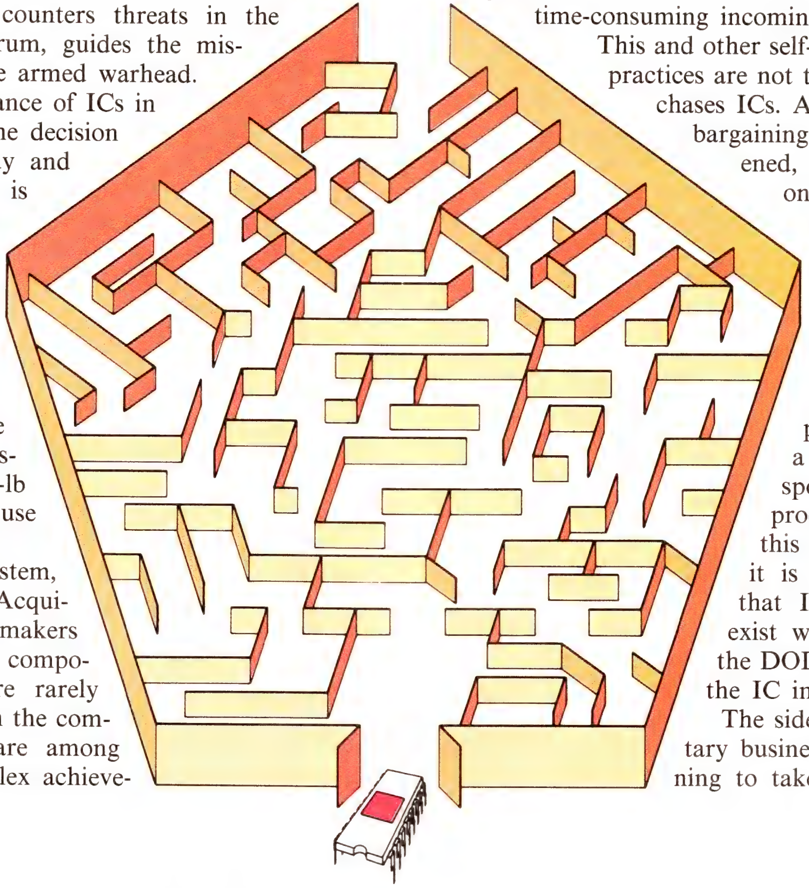
Despite the significance of ICs in military equipment, the decision on which ones to buy and the way to buy them is made by prime contractors and subcontractors based on requirements set by the Defense Department buyer. Semiconductor firms have little say. The competitive bidding system resulting in 60-lb computers remains in use for complex systems.

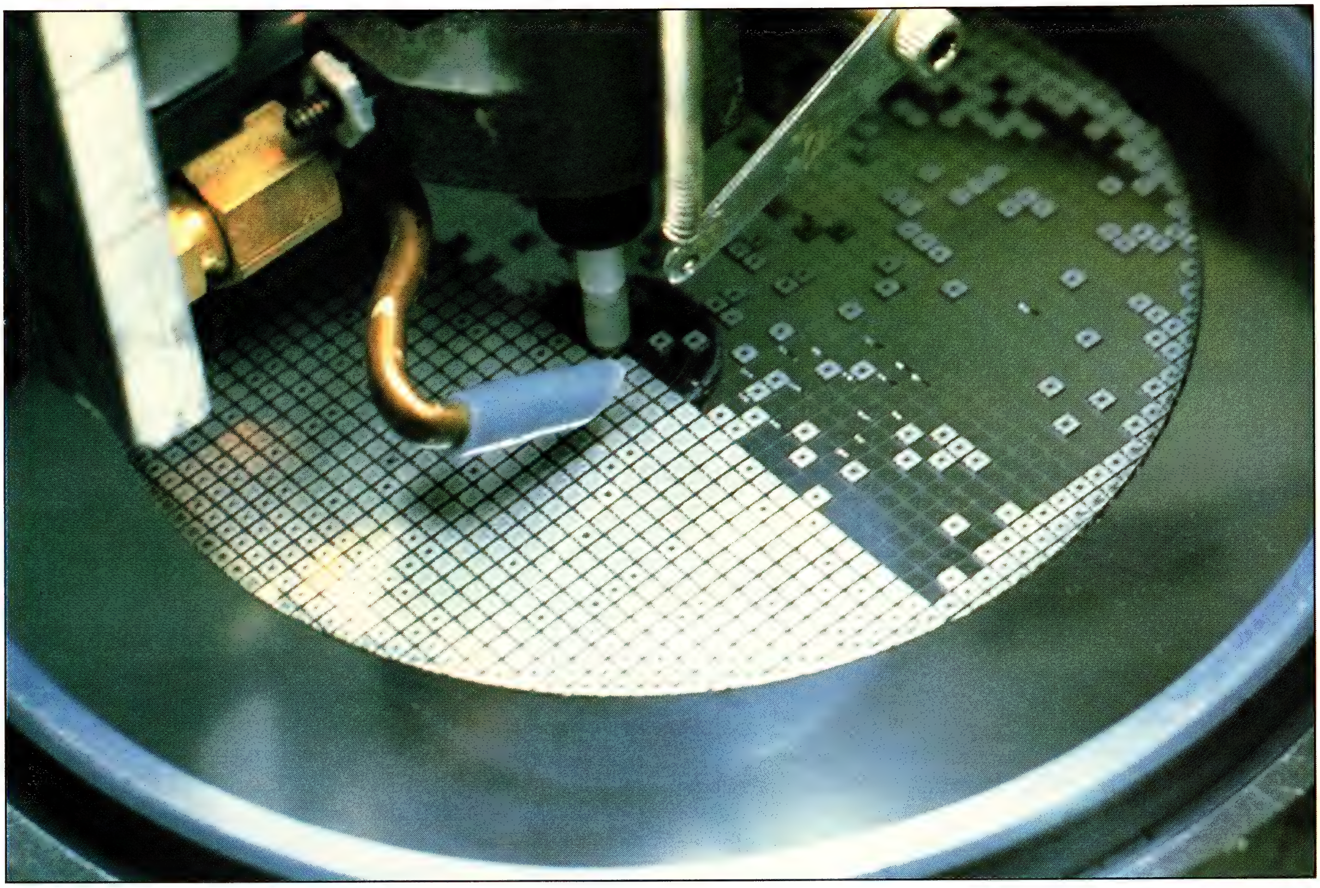
In this archaic system, imposed by Defense Acquisition Regulations, IC makers are treated merely as component vendors and are rarely consulted, even though the components they make are among mankind's most complex achievements. This is in stark contrast to business relationships that characterize the commercial market.

In the mainstream data-processing marketplace, for example, major IC vendors are forming technology and manufacturing partnerships with computer makers during the planning cycle for a new product. The result of this approach is that the correct IC designs are delivered to the buyer at the right time and price. Moreover, these ICs are so high quality and reliable (stemming from a zero-defects mentality under which they are now manufactured) that they can go directly to the the buyer's production line without the need for expensive and time-consuming incoming tests.

This and other self-regulating commercial practices are not the way the DOD purchases ICs. As a result, the DOD's bargaining position has weakened, while its dependence on electronic solutions has become fundamental. With more and more of a crucial system's design fabricated in ICs, it makes ever more sense for the DOD to place the IC vendor in a position of greater responsibility within the procurement cycle. But this is not happening. And it is increasingly apparent that IC manufacturers can exist without the DOD, but the DOD cannot exist without the IC industry.

The side effects of doing military business as usual are beginning to take a serious toll. First





1. Automating IC production. Semiconductor manufacturers that are investing their money in automation equipment, such as Signetics' die-selection station, are hampered by the lack of a single military standard that would apply to all integrated circuits.

and foremost, IC makers are hard-pressed to justify continued production of circuit designs that are totally obsolete in the commercial sector. Second, the lack of a cohesive manufacturing standard for military ICs creates chaos in factories, which, to be competitive, must automate their processes and techniques (Fig. 1). Third, the military procurement technique emphasizes testing and retesting at a time when dramatic improvements in process control obviate the need. In fact, it has been shown that excessive testing shortens circuit life by exposing ICs to inappropriate tests as well as to increased risk from electrostatic damage.

Military standards change constantly

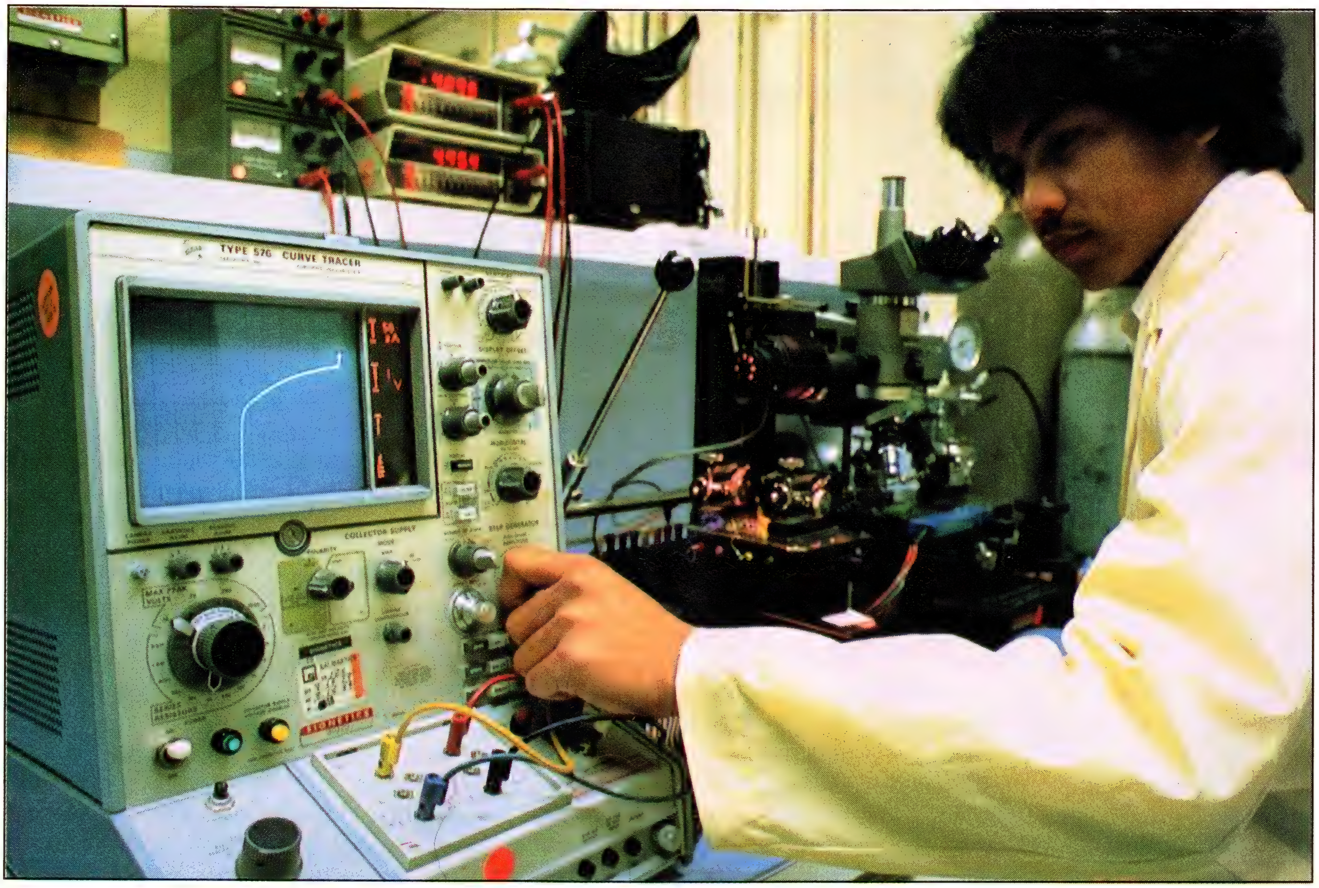
The problem becomes compounded for the IC manufacturer because multiple military standards (manfacturing specifications) change constantly. Because of the paper work and bureaucratic delays inherent in the procurement system, these changes usually take a year or more to be approved and incorporated into the system. Meanwhile, prime contractors' source-control drawings are infrequently updated to incorporate state-of-the-art processing, electrical, and environmental screening requirements. At the same time, IC makers are continually implementing changes for improvement in material, chip designs, and processes in order to remain commercially competitive.

It seems that an IC manufacturer should have no trouble choosing between a commercial opportunity with a 20-million-unit-per-year potential and a custom military design with a 100,000-unit potential. But if the manufacturer can factor in some portion of the commercial profits he would forgo, the military design could be made to appear more attractive.

But current DOD procurement policies do not account for lost business opportunities as a factor in cost. The sole available method to mitigate potential loss of profits is to design all products for operation across the military temperature range, then offer only standard, commercial circuit designs that can be screened to military requirements. Because only the screening portion of manufacturing represents the difference between commercial and military products, the vendor would not have to choose between opportunities.

However, the vendor does have to accommodate numerous different screening procedures, which disrupts the industry's incessant drive toward automation. In a typical setting, a manufacturer that offers 600 generic designs finds it necessary to create more than 100,000 unique part numbers just to account for the differences in screening demanded by various military customers. No parallel exists for this on the commerical side of the manufacturer's business. Screening accounts for more than half the price of a typical military IC and is potentially the most fruitful area in the process for improvement (Fig. 2).

Electronics has become the primary underpinning of the entire defense effort. The policy of the U.S. military is one of commitment to the pursuit of technical rather than numerical superiority, and technical superiority in



2. Military screening. More than half the cost of military ICs is attributed to the variety of screening procedures. More than 100,000 unique parts numbers are needed to list 600 generic types used by the military because of screening differences.

turn can be defined as "integrated circuit."

As the electronics portion of the military budget has increased, semiconductors have become an escalating subcategory. In 1984, microcircuits accounted for approximately $1.1 billion (2.3%) of the $48 billion electronics expenditure (Table). By 1988, microcircuit content is expected to increase to 3.2% of the electronics budget.

Beyond that, the system in silicon will increase semiconductor content at an even steeper rate. The commercial semiconductor market will continue to grow faster than the military market. By 1990, the military share could drop to less than 5% of the total market (which has grown at a lusty rate: around 40% in 1984). The shrinking percentage that the DOD represents simply increases the rate of obsolescence for military ICs.

The obsolescence problem

Product obsolescence has developed into a serious consideration for DOD users of ICs. Early technologies (resistor-transistor logic, diode-transistor logic, and p-MOS, for example) were discarded as better technologies were developed. Today, with the availability of high-speed CMOS and the various advanced Schottky families and semicustom (gate-array and standard-cell) products, standard TTL has been discontinued by most manufacturers. The obituary may already be written for the 54S and 54LS, the two most ubiquitous military-IC product families in weapons systems today. Discontinuing these chips should not be a catastrophe for designers, however: new families offer most of the product functions available within the older lines, and virtually all these functions are available in the semicustom form.

The stages through which a chip or a family proceeds from inception to discontinuation can be charted in terms of relative unit volume (Fig. 3). At some point in any product life cycle, demand will wane, with obsolescence just beyond the horizon.

In the commercial sector, end-product designers can rapidly move new ideas and new components into production. Many ICs that were released within the last 10 years have already been discontinued by their manufacturers, replaced by better designs.

The product aging cycle has created tremendous headaches for logistics managers charged with maintaining military electronics systems. The military product-life cycle has not deviated from what it was 50 years ago. Although defense designers seek the state of the art as avidly as their commercial counterparts, the cycle of test and retest within which they must operate hampers the ability to move quickly into production.

In an era when new products may last only 10 years, the DOD takes twice that to reach production release on key programs. For example, when the Aegis program finally received a production go-ahead, it was temporarily stalled by the large number of obsolete ICs on the parts list.

Prime aerospace contractors are just now writing proposals for a next-generation military fighter aircraft that is not expected to be operational before 1992, with pro-

TABLE: MILITARY ICs IN DEFENSE ELECTRONICS
(BILLIONS OF DOLLARS)

	1984	1985	1986	1987	1988
Defense electronics forecast	48.0	51.9	54.5	57.3	60.1
Military microcircuits	1.1	1.4	1.5	1.7	1.9
Percent of defense electronics budget	2.3	2.7	2.8	3.0	3.2

SOURCE: ELECTRONIC INDUSTRIES ASSOCIATION

duction extending well beyond the end of the century. More than 30% of the cost of this aircraft is projected to be spent on its electronics systems. Given its development, production, and life cycle, several generations of new ICs will come and go in that time. It is entirely possible that the children of the aircraft's designers will be flying it using obsolete electronics systems.

The military demand cycle is often out of sync with the product life cycle. (Fig. 4). For example, the DOD often needs a chip after it has disappeared from the commercial market. In many cases, because a system is still several years away from production, the manufacturer's obsolescence announcement goes unnoticed—thus locking obsolete ICs into the system design. Additionally, many fixed-price contracts do not allow for modification or schedule impact for other than a current parts shortage.

What the VHSIC program doesn't do

An exception is the current DOD-sponsored Very-High-Speed Integrated Circuits program, a multiyear, multimillion-dollar investment. The VHSIC program is obviously an attempt to return the DOD to the research and development mainstream. The VHSIC program is increasing the rate of technological development for signal processing (a key to many military applications) rather than for data processing, which dominates the commercial market.

On its face, the VHSIC program is a fresh breeze. At the same time, however, it has tended to isolate military semiconductor research from commercial research, particularly with its insistence on technical data rights that often involve processes or techniques developed outside its realm.

There is a stark reality about what the VHSIC program does not do. Now nearly seven years old, it has not increased the rate of technology insertion into production systems, although that is a goal of the next phase of the program. The test and retest cycle still impedes the equipment-development process.

The combination of single-year funding and archaic procedures for analysis of even the most minor proposed changes (and the rate of component obsolescence guarantees many minor changes) makes it nearly impossible for a new system, even one based on VHSIC components, to be placed into production in less than about eight years.

These concerns will become more severe in the future because of the growing level of IC understanding required for system design. It is obvious that the systems of the future will have to be faster, more powerful, and more compact. Much of the speed and power will be provided by extremely high-speed ICs with hundreds of thousands of transistors per die, further pressing their obsolescence.

In the past, the term vertical integration was used to describe a firm (within any industry) that controls everything from its own raw materials to its own channels of distribution. Today, there is a new form of vertical integration: the technology is vertically integrating itself. In 1965, a system designer who needed to gate several data paths on a board had only to decide whether to NAND or NOR them. He could select the proper gate without knowing what went on inside it. Even with complex chips of the day, he was able to work from the truth table without evaluating a chip's internal gating. Today, because individual ICs contain so many thousands more gates, system design and semiconductor design overlap.

Partitioning presents problems

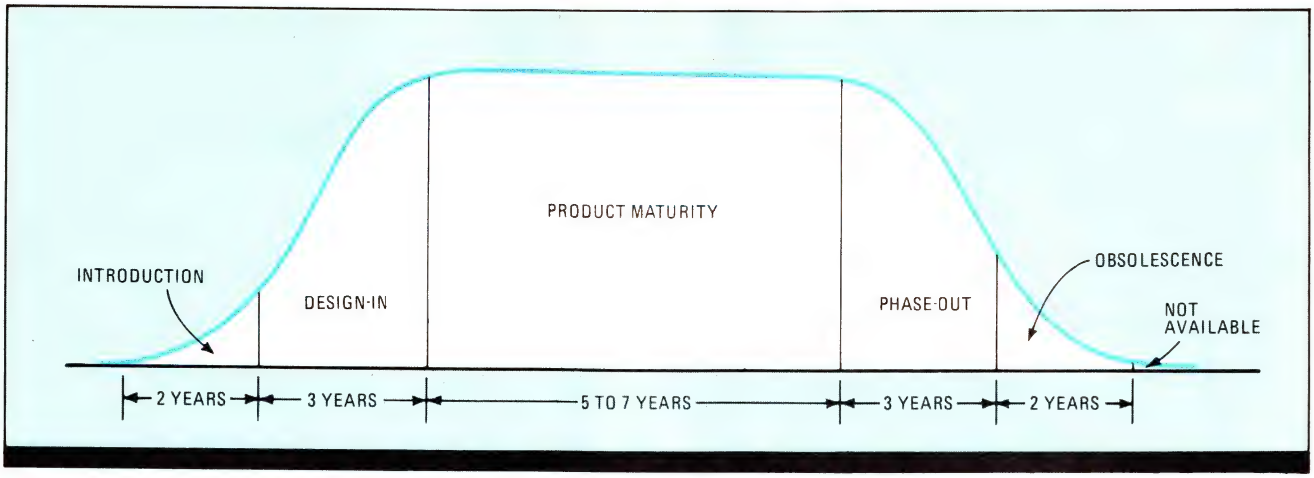
The overlap is obvious when a board design is partitioned in order to use custom or semicustom ICs. A commercial example demonstrates the dilemma that partitioning poses.

A recently introduced popular model of personal computer was first designed using several hundred commercially available standard ICs to emulate its architecture. All the circuitry was then placed in fewer than 40 semicustom ICs for tremendous savings in volume, power consumption, and cost.

This form of vertical technology integration means that the semiconductor industry of today is performing the same function as the systems industry of yesterday. But even using off-the-shelf devices requires partitioning the board design and makes necessary a thorough understanding of what goes on inside each chip. A designer who does not fully understand what happens to data once it is presented to a complex chip, such as Signetics' 68000 microprocessor or 8X305 microcontroller, is liable to find data going astray. The designer must understand the chip's internal timing delays in order to ensure the proper sequencing of data within the system.

It seems clear that the IC vendor, for this reason alone, needs to team his engineering force with the system designers who write the proposals for next-generation military electronics systems. The prime contractor no longer truly designs the circuitry; it is purchased in the form of highly integrated circuits. Defense acquisition techniques should reflect this fundamental shift.

In the commercial arena, designers have faced this challenge by consulting with semiconductor manufactur-



3. Commercial life cycle. In the commercial IC market, new products may last as long as 10 years before being pruned for newer designs. New ideas for new components are a critical factor in the highly competitve semiconductor industry.

ers during their design efforts. Quality organizations within systems houses now work closely with their vendor colleagues, because an obvious side effect of increased chip complexity has been increased test complexity. Test programs that could be prepared for simple chips in a few hours now take more than a year for the development of test software for a chip such as an advanced microprocessor.

Defects: to prevent or to detect?

As semiconductor complexity increased, managers responsible for product quality knew that their incoming test resources would be sorely strained in the development of test programs for complex chips. At the same time, an increased awareness of electrostatic-damage risks from additional chip handling influenced quality-assurance personnel to seek ways to eliminate incoming testing.

A more sensible way is to ask the IC vendor to guarantee the delivered product. As obvious as this method sounds, in actual practice it constitutes a revolution in the way business is conducted. Quality assurance historically has been an additive operation, tacked on after the completion of manufacturing to confirm that all steps were performed properly. But the new method is a total shift from the detection of defects to their prevention, leading to a participative concept of quality.

Under a prevention mentality, a vendor absolutely refuses to proceed with production unless all steps are perfected from the purchase of raw materials onward. Vendors that practice prevention today begin with a no-waiver policy in their purchasing departments. In 1984, several major IC vendors that had adopted a prevention progam in earlier years achieved defect levels so low that ship-to-stock programs became the reward. Incoming-test departments, which are very expensive to establish and maintain, are thus becoming obsolete.

While this revolution continues in the commercial market, it is a totally foreign concept in the military sector. The same IC that is shipped directly to the commercial buyer's production line has to survive a punishing set of military screening requirements, then a second set of incoming tests when it arrives at the factories of most military prime contractors.

No one will deny that most existing military screening is effective—in principle—in weeding out unreliable chips. All the various screens imposed on IC vendors, however, are no longer consistent with the extremely low defect rates being achieved by quality-conscious suppliers. These screening requirements were originally developed to ferret out IC-failure mechanisms that have long since been eliminated by process and material improvements. For the most part, ICs that fail the battery of military tests are being discarded because they do not meet a specification that may be highly irrelevant to the performance and quality of the product.

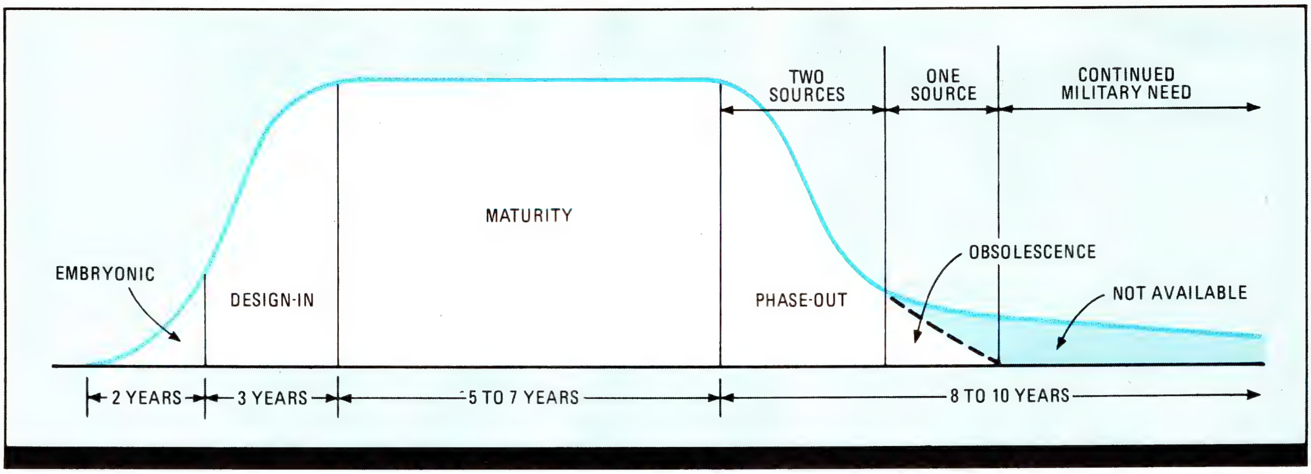
In the commercial sector, the introduction of statistical methods of quality control has augmented a zero-defects manufacturing mentality. Several vendors have reduced defects from about 10,000 parts per million a few years ago to less than 150 parts per million today. This success has brought a true zero-defect performance standard to the edge of the visible horizon. Some IC product lines, such as logic circuits, are now being shipped with a defect level less than 50 parts per million.

Vendor sets the standard

Under this philosophy, a vendor sets a standard, say 150 parts per million, which represents a realistic but tough level of electrical defects resulting from a given manufacturing process. This standard is applied using real-time statistical process-control techniques prior to traditional quality-control testing. The actual defect level experienced by customers is much lower, however, because the lot will not be shipped if the quality-assurance lot-acceptance sample contains a single defect.

Insofar as a military weapons system is concerned, a defect level of 0 parts per million is the only acceptable standard for all components and subassemblies. It should not go unnoticed that a vendor's process-quality guarantee of 150 parts per million is substantially better than any known military screening method now in use, including 100% retesting of ICs when they arrive at the prime contractor's factory. In fact, 300 parts per million is the level that has triggered most ship-to-stock programs in the commercial sector.

Given the ballooning base of evidence that this program works in the commercial sector, the DOD should



4. DOD life cycle. Although DOD buyers are eager to use state-of-the-art ICs for their weapons systems, their archaic procurement and test-and-retest policies may take 20 years for production releases on key programs.

seriously consider converting from detection to prevention as the basis for quality and reliability in weapons-system procurements. Because the DOD now charges the prime contractor with ultimate responsibility in quality matters, this proposal must factor in all subordinate contracting, not just ICs.

Recommended remedies

Further refinements to the military screening procedures must come through the incorporation of manufacturer-proven quality techniques, rather than through the imposition of screens developed in a laboratory environment that may not even approximate real production. Any vendor who certifies zero defects as a corporate quality standard, then proves its intent in the commercial marketplace, should get a hard look from DOD procurement executives who are also dissatisfied with the present system.

Additionally, the government must develop a system that views the cost of microcircuit procurement in terms of total cost of ownership. No testing will ever make a chip any more reliable than the day it is installed. Testing weeds out those ICs that are not reliable, but in the process uses some of the life of the remaining population. Prime contractors can attest to the fact that testing is a business of diminishing returns because fewer and fewer failures occur in lots shipped by contractors with a zero-defect approach.

Improvements in IC-manufacturing techniques have eliminated many significant types of failures. Continued retesting of today's chips after they have been shipped does not improve lot reliability—it adds cost. The handling involved risks inducing additional defects (particularly those related to electrostatic discharge).

DOD investigation and acknowledgment of these proposals should lead to the elimination of a vendor credibility gap that now results in such counterproductive procedures as 100% rescreening of all material. The gap is already fast disappearing in the commercial sector, where ICs from the most quality-conscious vendors are tested only as a completed system following subassembly or final manfacturing.

The U.S. semiconductor industry can continue to meet the needs of the DOD if steps to change the current procurement policies are taken. The first is the elimination of the prevalent and anachronistic "microcircuits are piece parts" mentality. The highly complex ICs that will provide the logic, memory, control, and sensory functions for the military systems of the future must be viewed as subsystems and not as components. This is important, because subsystem suppliers are usually involved in system planning from the initial proposal stage and have a voice in everything that occurs, including the opportunity to use their expertise to keep the entire team out of trouble. Microcircuit suppliers that are members of the team at an early stage can take all factors into account, including procurement cycles, obsolescence, technology-based needs (such as radiation hardening), life-cycle issues, and logistics.

Second, the potential for profit from supplying the DOD must be as attractive as that from commercial business. One compelling incentive would be the establishment of a single military and aerospace manufacturing standard to replace the multiple screens imposed by Joint Army-Navy and Specification Control Drawing and Vendor Standard procurement methods. With a single standard, an IC manufacturer could proceed toward automation and its attendant economies of scale. Of course, none of the existing DOD procurement alternatives constitutes a satisfactory single standard because all of them are based on defect detection. A new standard must be based on prevention—on a zero-defects mentality at all levels of the procurement cycle.

In a broader sense, the government could merit additional support from the microcircuit industry through a return to direct R&D investment with commercial vendors. This research and development should be focused into those areas in which little is done commerically; further, it should not be necessary for commercial competitors to acquire R&D contracts through VHSIC-like agreements. In other words, facility clearances and data rights should not be a factor in this form of sponsored research. The government could meet its unique needs while assisting vendors to accelerate their commercial R&D efforts. ☐

Ed Macaruso is military sales manager at Signetics Corp., Sacramento, Calif.

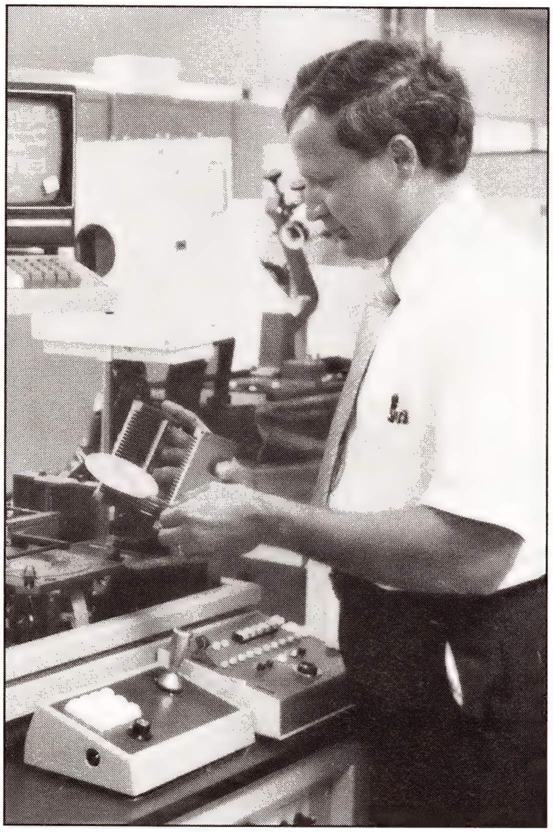
WALKING IN A MINEFIELD

Misunderstandings, contradictory and out-of-date specifications complicate the business of selling to the military

☐ *by Larry Waller*

The way old hands in the semiconductor industry tell it, selling parts to the U.S. military these days more closely resembles picking a path through a minefield than actually doing business.

For starters, government guidelines—the plethora of specifications that comes from numerous procurement agencies—not only often conflict but in many cases are hopelessly out of date. Mil Specs written for integrated circuits with a few transistors simply do not apply to parts with thousands of ICs. On top of that, alleged troubles with a single part type can taint an entire product line for months.



Argument. Technology used to make reliable components for commercial use has outpaced the testing-oriented mentality of Mil Specs, industry executives say.

Such is the way knowledgeable production and reliability officials throughout the industry portray dealing with the military's procurement requirements. They therefore generally agree with the main points made by Ed Macaruso of Signetics Corp. in his special report, "DOD Vexes IC Makers" (see p. 63).

But often their discussions are off the record, since wholehearted endorsement of Macaruso's argument would amount to a policy decision that could affect government business—and thus would have to be made higher up the management ladder. A don't-rock-the-boat attitude ensures that the strongest opinions are given only on the condition that the speaker not be identified.

Before any major improvements can occur in the procurement chain, it is clear from most comments that a fundamental lack of understanding must be corrected. This is nothing less than the recognition by government procurement authorities that the technology developed in fabricating highly reliable components for commercial customers has far outpaced the testing-oriented mentality embodied in Mil Specs.

Total control. Such major suppliers of commercial components as Motorola, Texas Instruments, and National Semiconductor continually emphasize that quality and reliability come only from the total control of all manufacturing steps—from wafer start through assembly—rather than from screening and testing done after the fact. It is doubtful whether government sources yet understand the logic of this.

Because most of the recent dust-ups in chip procurement deal with alleged shortcomings in testing, this is a sore point for all concerned (see "Delco, suppliers work together on reliability," p. 70). Some procurement agencies require 100% testing of all incoming parts by the military original-equipment manufacturer, after similar testing has been done by the supplier. The consensus in the semiconductor industry is that this move constitutes overkill.

"If this rule is carried out, it will negate what I think both government and the industry want," argues Joseph L. Flood, director of reliability and quality assurance for several IC divisions in Motorola's Semiconductor Sector. Flood, along with his industry peers, says that such retesting not only is very expensive but can in itself contribute to lesser performance down the line.

Just how badly retesting can affect reliability is not known for sure, but the companies believe it makes a big difference. "It's the difference between the 150 defects per million we guarantee our commercial customers, and from 1,000 and up for the military versions," says Derek Lidow, vice president for operations at International Rectifier Corp., which sells 20% of its power semiconductors to the military. In addition, some incoming test-procedure setups are so inept they can cause the number of faulty chips to skyrocket to 10,000 parts per million, he adds.

On the user side, however, contractors are not about to let down testing barriers, even if procurement authorities would let them. Hughes Aircraft Co., for example, whose manufacturing problems at its missile facility in Tucson, Ariz., held center stage for months, is even more thorough at its Radar Systems Group. Engineers there test incoming chips at both high and low temperature extremes, repeating this at the module and unit burn-in phases. "We aim at selecting the top 1% of the yield curve," says a Hughes official.

But the present troubles with military components cause "utter chaos" for users when a needed part type is suddenly removed from the government's Qualified Parts List. Once a part is removed, buyers find nothing but delays and unsatisfactory answers concerning when it might again be approved.

Why now? Vexing questions central to the current trouble—and so far unanswered—are why these troubles have flared up so suddenly, and how serious they are. Though little official enlightenment has been offered, some informed sources think they know what happened.

For several years, these sources say, some military buyers have been accepting Mil-Spec chips from a vendor without all specified tests being

Delco, suppliers work together on reliability

When it comes to a need for high-quality semiconductors that can withstand harsh environments, the automotive industry takes a back seat to no one. "The environment under the hood is worse than anything the military has," says John R. Stark, purchasing manager for General Motors Corp.'s Delco Electronics Division, in Kokomo, Ind. What's more, given the high-volume nature of the automotive business, the need for reliability is paramount, because component failures in the field could cause millions of dollars in recall costs.

The Pentagon could perhaps learn a lesson from Delco. Since the early 1980s, when the division began purchasing large numbers of integrated circuits for use in engine-control computers and other systems, Delco has compiled an impressive record of getting good parts from its vendors. And it has done so without the kind of testing and retesting that the military requires for its semiconductor components.

"I know the military depends heavily on testing. They spend on testing like money's going out of style," Stark observes. "But we just can't afford that, so we've had to take a different approach."

To be sure, Delco does require certain tests to be performed by vendors on every lot shipped, and the division retains the option to perform additional sample testing of its own on incoming lots. But Stark points out that "when incoming quality level reaches a certain point, you can actually do more damage by further handling and testing than if you just let it go dock to stock."

Instead of the heavy testing approach taken by the military, Delco greatly emphasizes process control and working closely with vendors when problems do arise. "We're continually working with suppliers on process changes and improvements that will, we hope, give us better reliability. We monitor that, and vendors don't make process changes without notifying us," Stark notes. As a deterrent to production problems and to make them easier to trace when they do occur, Delco specifies maximum lot sizes and requires vendors to identify the manufacturing site from which each lot is shipped.

Over the last few years, quality levels on incoming parts at Delco have been driven well down into the parts-per-million range. "We've got semiconductors right now that are running less than 100 ppm," says Stark. "Most if not all of our large-scale ICs are running in the 500-ppm range."

Though Delco still inspects most incoming lots, the division has qualified some parts for its NIV (for No Inspection Verification) program. Under NIV, conventional receiving inspection is eliminated on components from a vendor with a strong incoming-quality track record; testing is not done until the parts are built into the finished assembly.

When quality problems are detected, or when a vendor volunteers that a problem may exist, Delco sometimes steps up its testing of incoming lots of the component in question and then works with the vendor to iron out the difficulty. This contrasts with the military procedure of telling its contractors to reject all shipments from a vendor when testing irregularities are discovered. Stark thinks the military compounds the problem by taking such harsh measures. "If a vendor finds a problem and goes to the customer with it, and then gets raked over the coals publicly, I have a personal problem with that." –**Wesley R. Iversen** performed. This was done under mutual agreement, since both sides knew that more sophisticated tests already proven in commercial contracts fully exercised the proper parameters of the chips.

According to sources, the arrangement worked nicely, until someone blew the whistle and procurement agencies then applied the letter of the law. This explanation deals with incidents in addition to those attributed to lags in bringing source-control drawings up to date [*ElectronicsWeek,* Jan. 14, 1985, p. 20].

One recommendation that gets unanimous backing—and in fact has been sought for years from industry's side—is Macaruso's call for standardization. "There certainly is a dramatic need for it," says T.S. Edwards, vice president of National Semiconductor Corp.'s Military/Aerospace Products Group. TI, for example, until recently had about 15,000 source-control drawings to deal with, many with only slight differences in processing, testing, or characterizations. Similarly, Fairchild Camera & Instrument Corp.'s North America Semiconductor Group sees "proliferation of specifications as the core issue," according to William L. Kirkham, quality assurance manager.

Across the board, all hands agree with National's Edwards, who notes that a much higher degree of commonality could exist between MIL-STD 883, joint Army-Navy (JAN), and Defense Electronics Supply Center specs. Adds Kirkham, "The more you can standardize those, the less problem you'll have with control—and more than likely, you'll get better reliability as well."

Catch-22. For all concerned firms, one outcome of the recent trouble that most puzzles them is the Catch-22 of whether to voluntarily report problems that have not yet surfaced. "Fairchild, Signetics, and AMD all were hurt by blowing the whistle on themselves for military testing errors," notes William J. McLean, vice president of Integrated Circuit Engineering Corp., a research firm. Not only did they get into hot water on the specific programs they reported, he says, but the Army and Navy showed up and demanded audits on all JAN parts as well, which were not involved in the initial problem.

As for alleged short cuts in testing, whether or not they are made obsolete by newer testing technology, the industry verdict now rules them out. "Anytime anyone tries to take short cuts because they think a product is good enough, they are just sticking their necks out," warns Joseph Tirado, military high-reliability program manager for the microprocessor line in the Digital Product Division at Harris Corp. National's Edwards calls short cuts "the result of what I would term good commercial judgment but poor judgment from the standpoint of being legalistic."

Falling back to such an essentially defensive position, however, is not to the taste of a hard-charging industry that traditionally goes all out to incorporate state-of-the-art advances. "If we're only looking at legalese, we're losing the battle," says Motorola's Flood.

One fact cited by many sources: of all the chips involved in the Mil-Spec entanglements of the past year, there has not been a single documented hardware failure. For most industry hands, this means the components must be pretty solid pieces of work, despite all the unnecessary government requirements piled on them. ☐

DOD SEMICONDUCTOR TESTING PROCEDURE PROBLEMS

Company	Situation	Status
National Semiconductor Corp. Santa Clara, Calif.	Accused in 1983 by Department of Defense of falsifying semiconductor test data on chips.	March 1984, firm pleaded guilty to criminal charges and paid $1.7 million in fines and fees.
Texas Instruments Inc. Dallas, Texas	Inadequate testing of chips charged. September 1984, DOD directs weapons builders to withhold acceptance of components containing 6,300 types of TI chips.	Late January 1985, TI still negotiating details of test programs with some customers but claims virtually all chips have been reviewed and shipments have resumed. Process took three months to complete.
Signetics Corp. Sunnyvale, Calif.	Inadequate testing of chips charged. Early November 1984, DOD orders contractors to stop accepting equipment using over 1,000 types of Signetics' chips.	Firm close to resuming shipments on all suspected chips.
Fairchild Camera & Instrument Corp. Mountain View, Calif.	Fairchild notifies DOD in December that it has chip-testing problems and voluntarily stops shipping some 6,500 types of chips to users.	Company reviewing test procedures and making necessary changes. "No end yet in sight," reports William Kirkham, quality control manager.
Advanced Micro Devices Inc. Sunnyvale, Calif.	In December, voluntarily halts shipments of inadequately tested chips.	Firm hopes to clear up anomalies by end of March.

SOURCE: ElectronicsWeek

CIVILIAN CHIPS DON UNIFORMS

Chip makers find designing commercial products to meet stringent military specifications ensures faster introduction

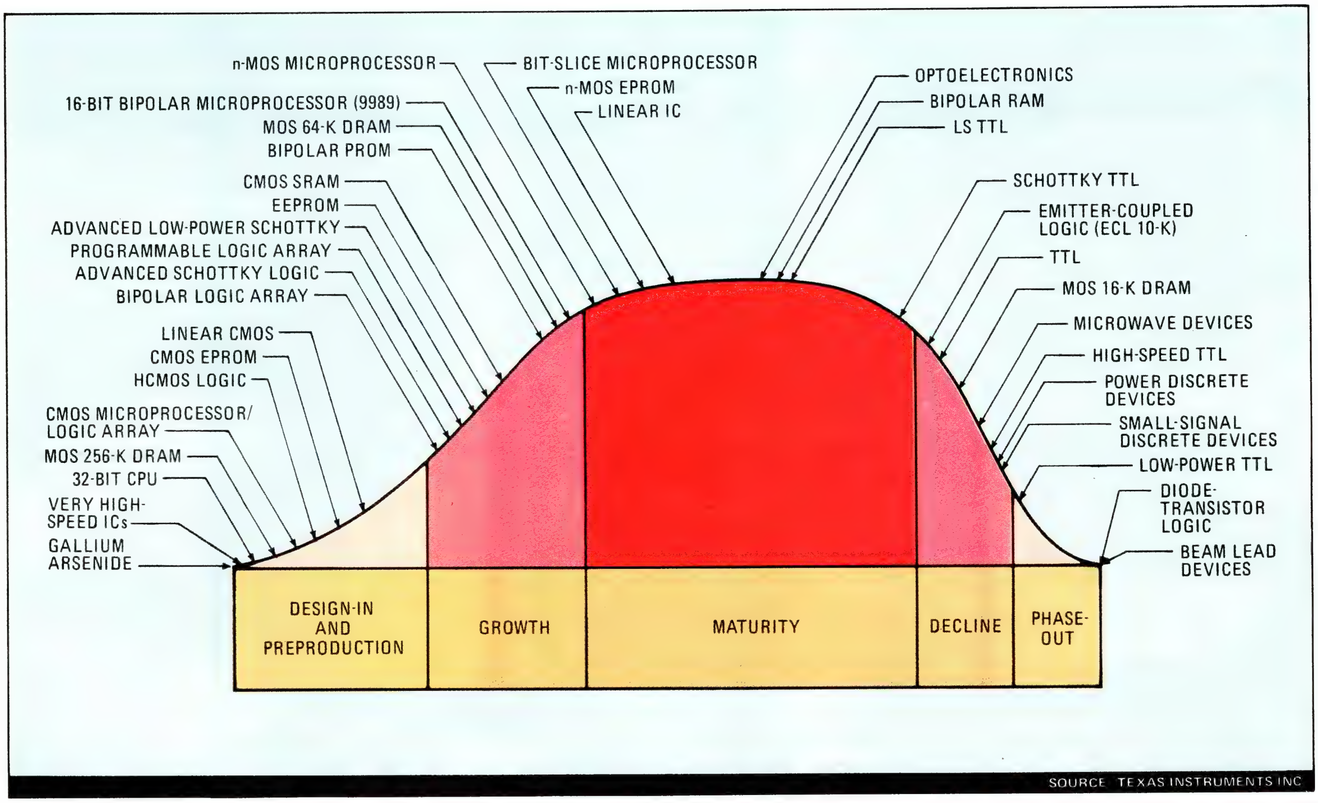
☐ *by J. Robert Lineback*

The term "military preparedness" has taken on new meaning for U.S. semiconductor firms. The steady parade of defense contracts plus an industry-wide migration to cooler-running CMOS circuits are encouraging firms to keep new military chips in lockstep with their commercial counterparts on the leading edge.

Managers of military-chip operations report that, close on the heels of many commercial product introductions, they are now often ready to deploy the initial wave of temperature-tough samples based on the same commercial integrated-circuit design. The return to quicker military-chip readiness is due in part to corporate mandates directing commercial designers to aim as often as possible for full military temperatures (–55°C to +125°C) in their specification targets.

Compared with the late 1970s, silicon houses report that more military-chip engineers are involved in the early stages of design definition. The intent is not only to share design resources more effectively but also to smooth the introduction of commercially developed parts into defense electronics portfolios.

Furthermore, the CMOS evolution in commercial markets is more than a welcome sight for most military-



SOURCE: TEXAS INSTRUMENTS INC

Growing. While the use of such mature products as TTL and MOS 16-K DRAM chips in military equipment is declining, vendors are starting to incorporate new technologies, such as gallium arsenide, MOS 256-K DRAMs, and CMOS EPROMs, in their offerings chip operations, which have found heat-sensitive n-MOS less suitable for military temperature ranges. For that reason, many note, military-chip markets have remained mostly a bipolar business, while commercial suppliers concentrated on low-cost n-MOS designs during the past 10 years.

"As the new CMOS and advanced low-power bipolar technologies come on stream in larger commercial markets, the temperature window is opening back up for us," points out Robert L. Veal, product manager for military semiconductors at Texas Instruments Inc.

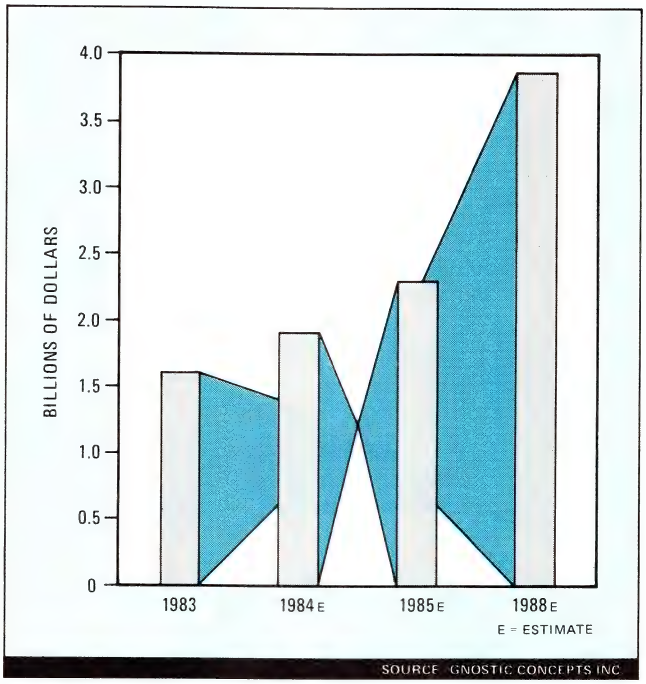
The critical -55°C-to-+125°C temperature range has not always been a hot button for commercial-circuit designers, however. During the 1960s, military markets drove semiconductor technology. Many commercial products worked quite well, but they did not always conform to the overall defense specifications (see chart, p. 74).

Back in the 1970s, however, design considerations shifted as the booming commercial demand dwarfed dwindling military purchasing. Military-chip operations began relying more heavily on commercial designs, which usually were optimized for low-cost production instead of harsh operating environments. But increased military spending and higher reliability standards in today's competitive commercial markets have led many chip houses to team their engineers from both sides of the business in chip development.

Industry leaders report their efforts are paying off as commercial-to-military design-turnaround times have often been reduced or nearly eliminated. That allows military-product operations to spend more of their engineering resources on packaging and test programs.

Consequently, product managers report they can speed up the introductions of military-temperature components screened to MIL STD 883. With design conversions easing somewhat, many suppliers are building up large arsenals of potential military products. These are waiting in the wings for demand to surface in the relatively slower-moving defense business.

As much as a year can be saved in long military design-in cycles by lopping off the time it takes to tweak commercial layouts for full temperature ranges. Ironically, however, defense procurement agencies are not yet ready for quick introduction cycles, many military-chip managers complain. Some worry that a sudden flood of new designs could compound the already tangled qualification process.



Healthy. The military market for integrated circuits, which hit $2 billion last year, will rise to $2.4 billion this year, and it is estimated that it will rise close to the $4 billion mark by 1988.

But leading-edge integrated circuits are marching into the military markets at a surprising pace. For example, the Military Products Department of TI's Semiconductor Group has been shipping samples of an n-MOS 256-K-by-1-bit dynamic random-access memory months ahead of the official commercial introduction set for later this year.

TI applied a similar quickened pace for sending out samples of the military versions of its 15-ns programmable logic arrays, made from its most advanced 2-μm bipolar process [*ElectronicsWeek,* July 23, 1984, p. 21]. At Signetics Corp.'s military products operation, product managers are readying military versions of CMOS 64-K erasable programmable read-only memories as well as full-temperature versions of 16-bit 68000 microprocessors. Mostek Corp. is already selling military versions of its 68000 chips.

Management is involved. "Today, we have upper-management directives that say designers must attempt to design every new circuit for the full military temperature ranges, regardless of whether or not it is a candidate for military markets," notes Richard Lambert, quality and reliability assurance manager for Signetics' Sacramento, Calif., operation, which brokers chip designs and fabrication from the firm's nine commercial IC units. Many other suppliers are also shooting for the military temperature ranges in chip development to provide higher reliability in the commercial and industrial markets.

"Nowadays, there are a number of reasons for full-temperature specs—not the least of which is yield improvement between 0°C to 70°C," says Ray Slusarczky, product marketing manager at Intel Corp.'s military-circuit operation. "You've got demands from the automotive marketplace requiring something beyond 0°C to 70°C, and the military as well, of course."

By designing initial commercial ICs to meet the full temperature ranges, 6 to 12 months are eliminated from the time it takes to change chip-mask levels, adds Steve Davis, strategic programs manager at Intel. The company tries to begin sampling military-tempera-ture chips within 30 to 90 days of a standard commercial product's introduction.

Despite early availability of military-temperature parts, companies must still wait for lagging demand in defense markets before pushing ahead with the introduction of state-of-the-art products, comments Doug Zuberer, military marketing manager at Advanced Micro Devices Inc. The firm designs all new products to meet full military temperature ranges, but it sees no demand yet for advanced microprocessor products, such as its new 32-bit bipolar chip. "So it is likely to be some time before that product will be introduced in military markets," Zuberer adds.

Effects of competition. Memory pricing competition with Japanese producers in the late 1970s caused many commercial n-MOS chips to be less suitable for military uses, notes Bobby G. Quinn, marketing vice president of custom ICs at Harris Corp. To compete with the lower prices of Japanese companies, U.S. memory makers had to push their design rules to make dies smaller, resulting in n-MOS circuits that often would not perform properly at high temperatures.

"Looking back 15 to 18 years, products like the 5400 TTL families were put on the military and commercial markets simultaneously," recalls Quinn. "It was relatively easy to do that because functions were simple small-scale integration. But we got away from that in the area—mostly memories—where U.S. companies were competing head-on with the Japanese. Military did not keep up during that era.

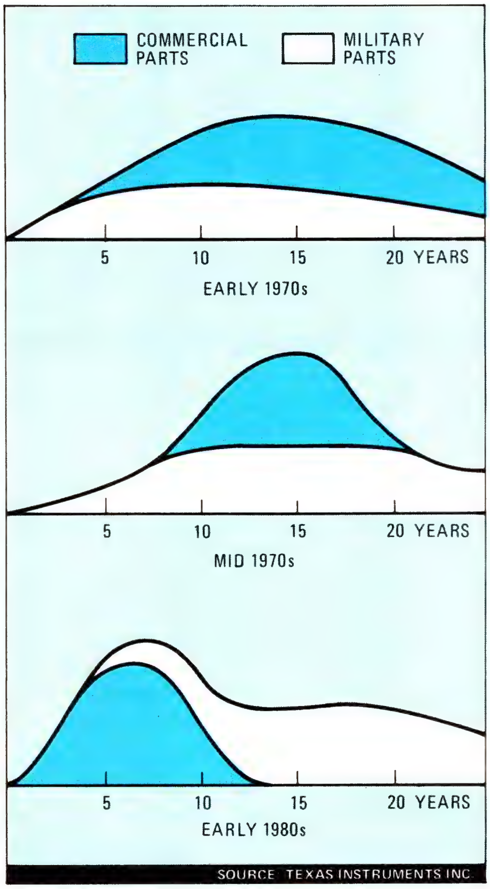
"Today, I see the industry's effort as a Herculean task of hitting the state-of-the-art functions early in chip life cycles to take advantage of military opportunities. That's what we are now seeing and are attempting to do at Harris," he states.

Fairchild Camera & Instrument Corp. recently reorganized its Digital Logic Unit to facilitate military-product introductions within weeks after the announcement of their commercial equivalents, says Will Steffe. Steffe is now general manager of Fairchild's six-month-old Aerospace and Defense Division, which plans to initiate a quick-introduction program on Fairchild Advanced Schottky TTL bipolar logic components in the second quarter.

"The major way to shorten cycles is to plan ahead in manufacturing and engineering," he says. Once the designs are completed and the initial parts are fabricated, Fairchild's military operation begins its characterization tests, at about the same time that commercial evaluations of packaged chips begin.

Ron Marfil, director of military/aerospace product marketing at National Semiconductor Corp., believes reduced commercial-to-military design conversions are possible partly because of advances in test-equipment capability and a better understanding of military specifications. The gap will continue to narrow, he says, with improvements in engineering work stations and silicon-simulation software. "We are getting a lot better at predicting what devices will be capable of doing before we even see silicon."

Technology wave. In addition to advances in design tools, many military-chip suppliers are gearing up to ride the CMOS technology wave currently spreading through commercial markets. The low power dissipation of the new circuits already enables commercial designs to operate over a much broader temperature range. RCA Corp.'s Solid State Division, for example, plans to introduce military-tough high-speed CMOS logic—what it calls QMOS—within three months after commercial parts are unveiled, says Jack Handen, manager of product marketing for high-reliability chips.



SOURCE: TEXAS INSTRUMENTS INC

Flip-flop. In the 1970s, consumer chips came out after military parts, but by the mid-1980s consumer ICs were coming out before the military gear.

"We are doing our homework. During the commercial characterization of devices, we piggyback our work in concert so, when specifications are developed, it already includes full temperature ranges. With little effort we can make available parts through proper screening and testing," Handen says. RCA brought out some 80 QMOS parts in high-temperature versions during late 1984. It will add 25 parts to the military family each quarter this year.

Still, Handen cautions that not all CMOS technologies are easily adapted to military temperature ranges. "As you go into large-scale integration, many of the more exotic CMOS processes—especially those with poly resistors or those mixing n-channel interiors with complementary interfaces—have limited temperature ranges."

Future divergence of processing technology trends in military and commercial markets may make it more difficult to piggyback development of chip designs, says TI's Veal. He believes that military packaging and radiation hardness requirements are likely to widen the gap between commercial and military design considerations.

"One way to tackle radiation problems is directly through silicon but that's a costly approach with divergent issues," Veal says. "The other is through systems architecture with error-correction schemes or testing methods in the logic, monitoring functions in harsh environments."

Intel is finding, however, that the new processing techniques, geometries, and materials used in its MOS designs have not only increased performance, but also raised tolerance to radiation [*ElectronicsWeek,* Jan. 1, 1985, p. 89]. "Thinness and purity of the oxide have allowed our parts to exceed tactical radiation levels with off-the-shelf HMOS [high-performance n-channel]," Davis says. "These exceed the VHSIC goals in Phase 1, and CHMOS will continue on that path." ☐

CODE READER IS SAFE TO USE

Laser-based hand-held bar-code reader from Belgium scans and decodes labels at distances of up to 8 in. ☐ *by Steve Zollo*

Use of the Laserscan 7000, which has a Laser Class 1 approval rating, affords no danger to operators or other people nearby. The hand-held laser scanner for bar-code reading also carries a safety standard rating of 76 from the International Electrotechnical Commission.

The light and compact Laserscan 7000 combines the speed and accuracy of fixed-laser scanning equipment with the convenience and versatility of the much slower wand-type units currently used for bar-code reading in a wide variety of applications.

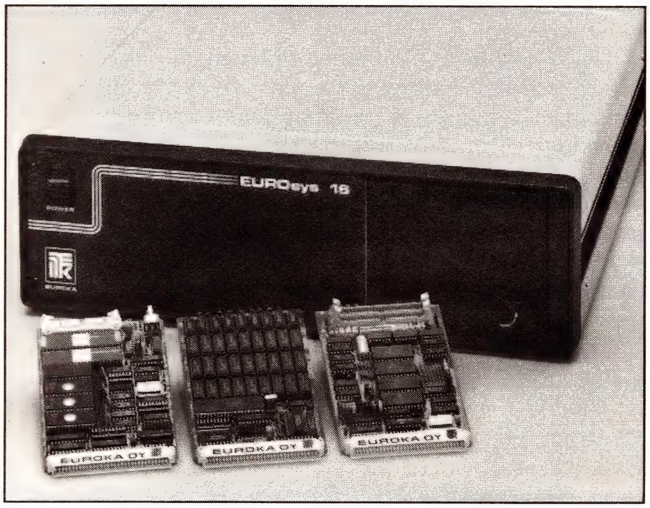
It instantly decodes all the popular bar-code systems now in use, on all types of product shapes and surfaces, at distances of up to 8 in. The Laserscan 7000 can be integrated with a variety of data-gathering systems.

Symbol Technologies Inc., rue Gachard 51 Bte 19, 1050 Bruxelles, Belgium. Phone (010) 322-640-92-32 [Circle reader service number 445]

Multiuser system supports 68000 processors

A multiuser program-development system, the Eurosys 16, provides total support for the 68000 series of microprocessors. Its OS-9/68000 operating system, which is written in the C language, is compatible with the AT&T Bell Laboratories' Unix operating system.

The Eurosys 16, which is built on Eurocard-size boards, is based on the company's Euro-6/16 microcom-



puter modules. The modular system has 13 free slots available for target expansion.

The hierarchical structure of OS-9/68000 simplifies the organization of target software. Program revisions and extensions are simple to implement.

The tree-like structured file system of OS-9/68000 makes file manipulation very straightforward. Because all OS-9/68000 time-critical sections are coded in assembler language, system response time is only milliseconds.

Euroka OY Elektroniikka, Hämeentie 155 C 52 A, 00560 Helsinki 56, Finland.
Phone 358-0-799522 [Circle 440]

64-K-by-1-bit RAM accesses in 80 ns

At a blazing 80-ns access time, the IMS 2600P-80 is Inmos's fastest random-access memory. The 64-K-by-1-bit RAM has a 130-ns cycle time.

The 80-ns part offers such features as column-address-strobe before row-address-strobe refreshing and a nibble mode that gives 4-bit serial access at a 48-ns data rate. With faster processors continually available, many high-performance applications, particularly in computer-aided design and graphics, can use this speed.

Manufactured in the company's sub-2-μm n-MOS technology, the IMS 2600P-80 is packaged in the Joint Electron Device Engineering Council standard 16-pin plastic dual in-line package. The price for each of these RAMs, in quantities of 100, is $12.45. Delivery takes six weeks after receipt of order.

Inmos Ltd., Whitefriars, Lewins Mead, Bristol BS1 2NP, England.
Phone (0272) 290861 [Circle 442]

Digital filter can be multiplexed many ways

For use in digital telephone exchanges such as the System X, the MS2014 filter and decoder circuit functions as a tone detector and extracts signaling information from digitized channels. The integrated circuit, which is manufactured in n-MOS process, is suitable for performing filtering on any digitized signal in the range from dc to 32 kHz.

The IC consists of a second-order digital filter section, which can be multiplexed, plus 16 leaky integrator, detector, and rectifier sections on a single chip. By changing the multiplexing format, it is possible to combine the filters effectively in several ways. A maximum complexity of the 16th order is obtained by successively using the second-order filter section eight times.

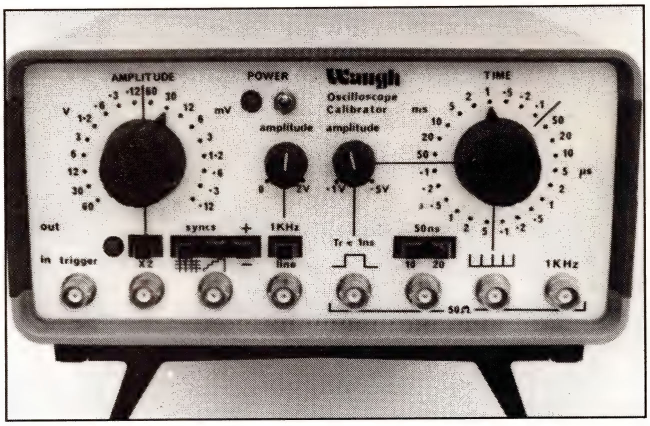
Each section's characteristics are controlled by coefficients stored externally in a random-access or a read-only memory. The coefficients can be changed at the sample rate of 8 kHz; each sample can therefore be effectively applied to a different filter. The filter and decoder circuit is suitable for signal extraction in instrumentation and spectrum analysis.

Plessey Semiconductors, Cheney Manor, Swindon SN2 2QW, England. Phone (0793) 36251 [Circle 446]

Oscilloscope calibrator sells for less than £500

Priced under £500, the Waugh oscilloscope calibrator provides all the signals necessary for checking performance and recalibrating oscilloscopes up to 150 MHz in bandwidth. A calibrated-amplitude square-wave generator checks correct adjustment and accuracy of input attenuators.

A wide range of timing signals from an internal crystal-controlled oscillator provides pulses with periods from 10 ns to 5 s. Vertical amplifier rise time can be checked with a clean square pulse (with a rise of less than 1 ns). Two sinewave outputs of 1 kHz and an ac line supply frequency can be used for checking correct level-selecting of trigger circuits and for locking the sweep circuits to the ac supply line when checking vertical amplifiers for line hum.



Oscilloscope synchronization separators used for TV measurements can be checked with the full interlaced composite video output—both positive- and negative-going video—being provided.

Waugh Instruments Ltd., Otter House, Weston Underwood, Olney, Buckinghamshire MK46 5JS, England.
Phone (0234) 712445 [Circle 443]

Switching power supply boasts 150-kHz frequency

The Switchpac dc-to-dc converters are plug-in power supplies in Eurocard format. Using MOS FETs in the switching circuitry, the units have a clock frequency of 150 kHz.

Versions are available with the following outputs: 5 V at 5 A, 5 V at 10 A, 12 V at 4.2 A, 15 V at 3.3 A, 18 V at 2.8 A, and 24 V at 2.1 A. The supplies accept an input voltage of 24 V dc. The outputs are protected from short circuits and overvoltage.

Overload protection, external on/off switching through logic signals, soft-start, and galvanic separation between input and output voltage make for a wide range of applications, according to the company. The 5-V/5-A model sells for 325 DM each on the German market.

Schroff GmbH, D-7541 Straubenhardt, West Germany [Circle 441]

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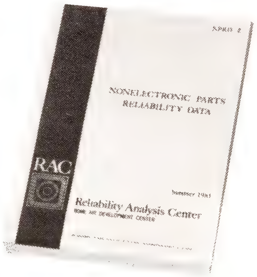
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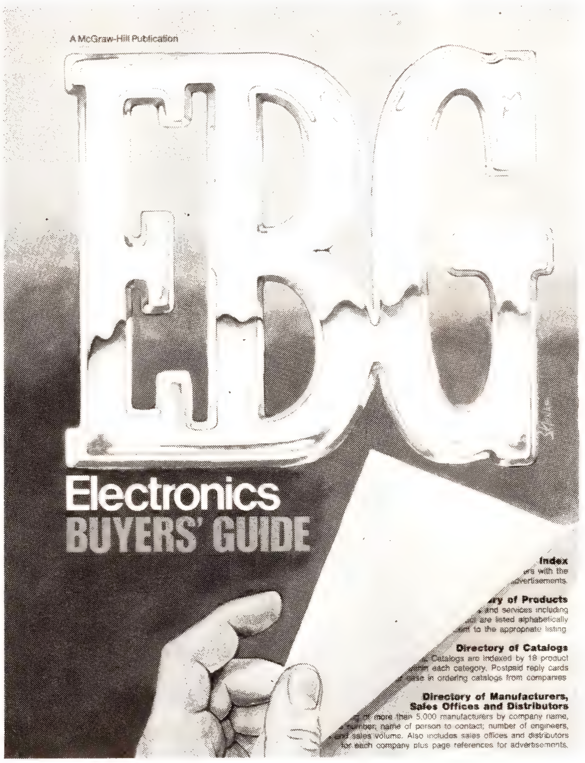
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UNIT TAKES ICs FROM BOARDS

System unloads bad ICs from burn-in test boards and sorts them into carrier tubes automatically

☐ by Steve Zollo

Every step in the production of printed-circuit boards is grist for the automation mill—the latest being burn-in test board handling. Reliability Inc.'s Intersort system unloads integrated circuits from burn-in boards, sorts them according to test results, and loads them into carrier tubes—all automatically.

Designed for high-volume burn-in and test operations, the Intersort system is microprocessor controlled. It accepts test data from a host computer in a network environment or reads data from an on-board 5¼-in. floppy-disk drive.

The user positions the burn-in boards, presses a start button, and replaces the carrier tubes as the sorter fills them. An alphanumeric display provides operator prompts and error messages. The system automatically runs extensive safety checks to detect such problems as device jams or missing parts.

According to the company, the Intersort system eliminates many of the handicaps of manual IC removal and sorting. For instance, workers previously have been required to visually check a board map as they remove individual ICs from burn-in boards, which leads to high error rates in the sorting process. What's more, the system can remove and sort 4,000 ICs per hour—faster than can be done by hand.

Standard Intersort systems can sort up to 10 different test categories, but the company can custom configure systems to handle more. It takes 3 min to unload a typical board.

Intersort handles all standard IC packages, both plastic and ceramic. Its unloading system ensures rapid IC retrieval without damage. After removal, the progress of ICs through the sorting process is automatically verified; any jams or stoppages cause the system to halt, and alarms notify the operator.

To ensure that the proper ICs are removed from the correct board, the system checks the serial numbers of boards as it prepares to unload them and verifies test results. If a board's serial number does not agree with the number provided by the host computer or read off the disk, or if the device count on the board does not agree with the record, the system automatically alerts the operator. After verification, a sort map is downloaded to the system microprocessor and unloading proceeds.

The system weighs 750 lb and occupies approximately

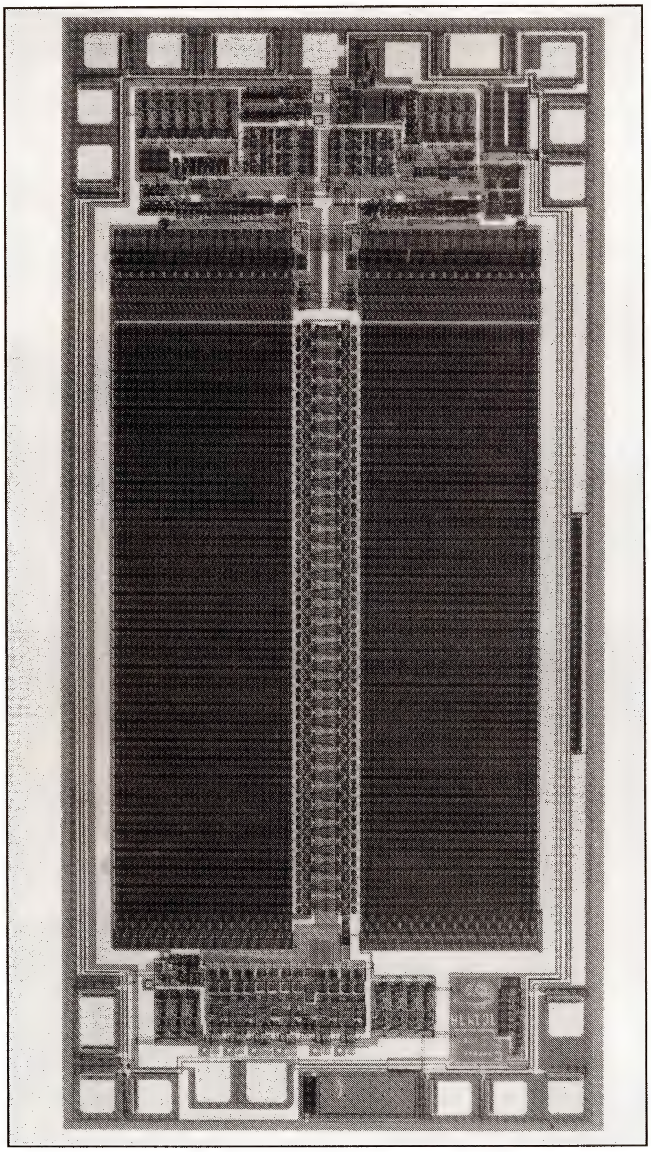
2 m² on the floor. Available 90 days after receipt of order, the Intersort sells for about $70,000.

Reliability Inc., P.O. Box 218370, Houston, Texas 77218. Phone (713) 492-0550 [Circle reader service number 338]

Low-power CMOS SRAM accesses data in 25 ns

At half the power of n-MOS-fabricated memories, this 4-K-by-1-bit CMOS static random-access memory is nonetheless able to access data in 25 ns. The speed of the model CY7C147 makes it desirable for designs that require 4-K-by-4-bit parity. In addition, its reduced power consumption—440 mW active and 55 mW standby—lowers the die temperature, which minimizes thermally accelerated failure.

Latchup, a key problem in CMOS technology, has been prevented by using substrate bias generation techniques in manufacture. All pins are protected to over 2,000 V of electrostatic discharge, and 10% power-supply voltage tolerance increases the system margin.



CY7C147 SRAMs come in standard 18-pin, 300-mil ceramic and plastic dual in-line packages for the commercial temperature range and in Cerdip packages for the military (–55°C to +125°C) temperature range.

Ordered in plastic in quantities of 100, the CY7C147-45 sells for $7.13, the CY7C147-35 for $8.63.

Cypress Semiconductor Corp., 3901 N. First St., San Jose, Calif. 95134. Phone (408) 943-2614 [Circle 340]

Six static RAMs make up wordwide memory module

Six 8-K-by-8-bit CMOS static random-access memories mounted on one dual in-line package make up the EDH81624C, one of a family of wordwide memory modules. Fully CMOS, the module has a maximum power dissipation of 525 mW, making it appropriate for lower-power applications, including battery operation. It requires a single +5-V power supply.

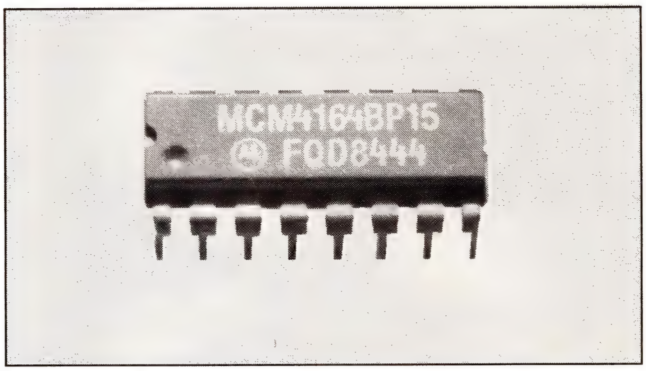
The dual-sided 40-pin DIP is compatible with the 40-pin industry standard, as well as with other wordwide memories from the same manufacturer—SRAM, erasable programmable read-only memory, Combo (a combination of SRAM plus EPROM), and electrically erasable PROM. Available in versions with 120-ns or 150-ns access times, the EDH81624C is priced at $589.50 in lots of 1 to 25 pieces; delivery takes 10 weeks.

Electronic Designs Inc., 35 South St., Hopkinton, Mass. 01748. Phone (617) 435-9077 [Circle 342]

64-K dynamic RAM contained on smaller die

Featuring a reduced die size, the MCM4164BP15, a 64-K high-performance MOS dynamic random-access memory, accesses data in 150 ns. Maximum power dissipation is 302.5 mW in the active mode and 22 mW when on standby. With a 128-cycle, 2-ms refresh rate and page-mode cycle time of 155 ns, the MCM4164BP15 maintains upward pin compatibility from the 16-K MCM4116 RAM and the MCM4517 RAM, as well as being fully TTL-compatible.

By multiplexing row-and-column-address inputs, the RAM can be contained in a standard 16-pin dual in-line package. The MCM4164BP15 64-K DRAM is available now. It is priced at $5.74 each in quantities of 1 to 24, at



$5.57 each in quantities of 25 to 249, and at $5.18 each in quantities of 250 to 299.

Motorola Inc., Memory Products Division, 3501 Ed Bluestein Blvd., Austin, Texas 78721. Phone (512) 928-6700 [Circle 341]

Two DACs on one chip serve high-density needs

A dual 8-bit parallel digital-to-analog converter, the MP7528, utilizes monolithic CMOS technology in which two DACs are fabricated at the same time and on a single chip. This, the manufacturer says, matches linearity, gain, and accuracy, and ensures that the DACs will track well with temperature.

The MP7528 is bus-compatible with most 8-bit microprocessors; it interfaces with a microprocessor through separate on-chip latches. Other features are linearity up to ±⅛ least significant bit, guaranteeing monotonicity; single-supply voltage (+5 to +15 V) that dissipates less than 20 mW of power and comes with full MIL-STD-883B processing; and TTL and CMOS compatibility.

The MP7528 comes in a 0.3-in-wide dual in-line package with 20 pins and is offered in 7-, 8-, 9-, and 10-bit linearities. In 100-piece quantities, prices are $5.80 for the MP7528JN (plastic, commercial), $9.75 for the MP7528AD (Cerdip, industrial), and $19.55 for the MP7528SD (Cerdip, military).

Micro Power Systems Inc., 3100 Alfred St., Santa Clara, Calif. 95050. Phone (408) 727-5350 [Circle 344]

Thin-film hybrid ADC features 10-bit resolution

A 10-bit, 800-ns successive-approximation analog-to-digital converter, the AD ADC-816, includes a clock output pulse to synchronize the serial output data. This eliminates the need to build a serial data-recovery system. The converter has a conversion time-temperature coefficient of ±0.06%/°C (typical), and the +15-V supply tolerance is ±0.3 V.

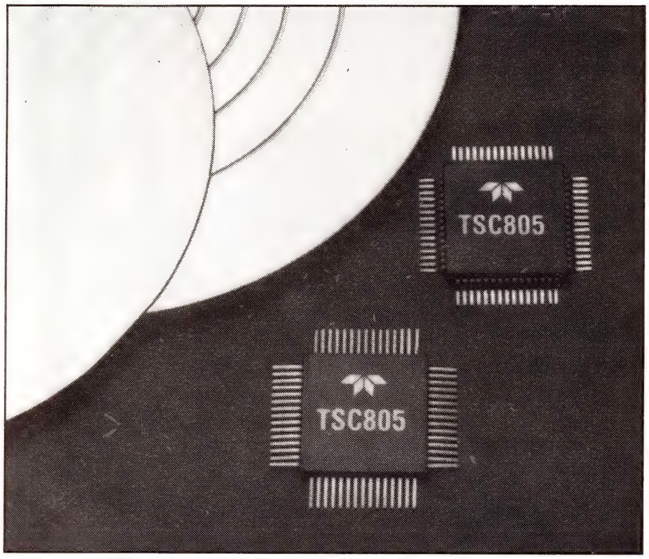
It provides six analog input configurations and unipolar or bipolar operation. Output data comes in serial or parallel format. Operation over temperature is guaranteed to have no missing codes and a maximum differential nonlinearity of ±½ least significant bit.

The AD ADC-816 is a thin-film hybrid in a 32-pin dual in-line package. Three grades are available: KD (0°C to 70°C), BD (–25°C to +85°C), and SD (–55°C to +125°C). Single-order prices range from $202 for the KD grade to $290 for the SD grade. Delivery takes up to eight weeks for BD and SD grades.

Analog Devices Inc., 7910 Triad Center Dr., Greensboro, N.C. 27409. Phone (919) 668-9511 [Circle 345]

CMOS converter offers 22 measurement ranges

In a single package, the TSC805 analog-to-digital converter offers 22 operating measurement ranges: nine are for dc-ac voltage, four for ac-dc current, and nine for resistance and low-power ohms. Autoranging works for resistance scales from 200 Ω to 2 MΩ as well as for voltage ranges from 200 mV to 2,000 V. The converter is available with two manual current ranges—20 mA and 200 mA—and it uses a single input line so that it can change ranges manually.



The TSC805's triplex liquid-crystal-display drive is on chip, as are its voltage reference and two-digit memory for relative measurements. In memory mode, measurements are made and displayed relative to a user-stored constant offset.

Noise is typically 20 μV. The proprietary CMOS metal-gate manufacturing process gives a 200-mV full-scale input voltage range, equivalent to 100-μV sensitivity. The maximum internal voltage reference drift of the TSC805 is 50 parts per million/°C.

The TSC805 ADC comes in a 0.5-in.^{2} plastic quad flat package. In hundreds, units sell for $13.20 each. Samples are available now, with production-quantity delivery made in 8 to 10 weeks.

Teledyne Semiconductor, P.O. Box 7267, Mountain View, Calif. 94039. Phone (415) 968-9241 [Circle 343]

Conformal coating system bypasses masking process

With a dip tank measuring 27 by 102 by 35 mm deep, the JMC 2T Minicoater is designed for research, prototyping, and low- to medium-volume production. A clamp with an adjustable stop controls the immersion operation; this, the company says, eliminates the need for masking. Each step of the process is timed and repeated by means of a digital timer.

A complete system, the JMT 2T Minicoater does not require turbine blowers or air dryers to liquefy the coating powder. Instead, a small industrial compressor can supply the 80 lb/in.^{2} of air it uses.

Two medium-wave infrared ceramic heater troughs are individually adjustable for regulation of the distance from the component to the heating surface. The JMC 2T

How to keep from the electronic war.

being a casualty in

Is the electronics industry going the way of other industries?

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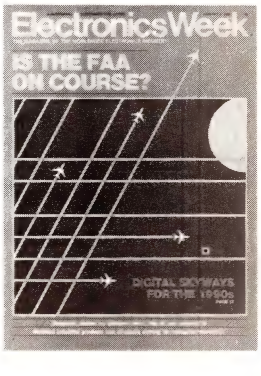
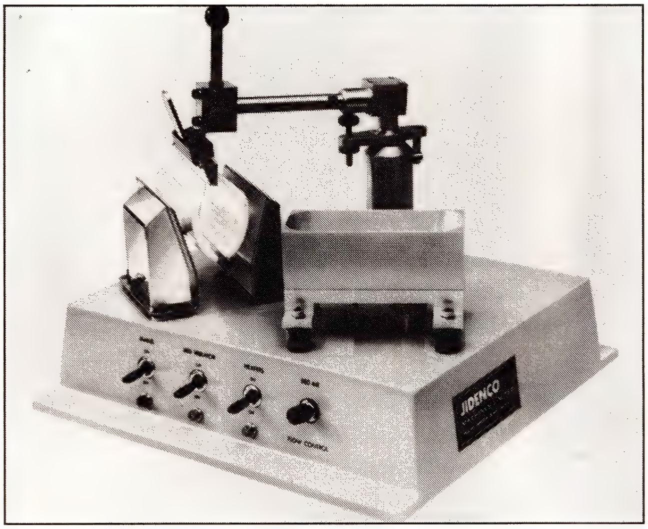




Minicoater carries a $2,375 price tag. Delivery takes two to four weeks.

Peter Fodor Associates Inc., Overseas Consulting & Sales, P.O. Box 474, Snowdon, Montreal, Canada H2Z 1T2.
Phone (514) 397-9933 [Circle 346]

Cutter trims leads on six boards every minute

Using a vacuum hold-down system with safety interlocks to eliminate mispositioning of boards by the operator, a spinning knife-edge cutter trims leads at the rate of six boards/min. The Lead-eater will accept boards up to 12 by 18 in. This mass lead-trimming machine makes its own fixtures, the manufacturer says, and can accommodate irregularly shaped boards and overhanging components. A built-in hone keeps the cutting edge sharp. Complete and ready to use, with vacuum pump, carbide trimmer blade, templates, and accessories, the Lead-eater is available now, priced at $6,795.

Microscan Inc., 6505 218th St. S.W., Mountlake Terrace, Wash. 98043. Phone (206) 771-2310 [Circle 347]

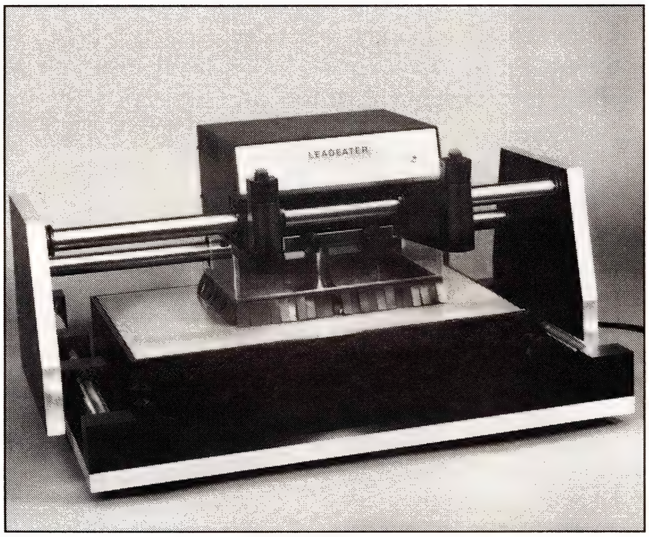


Image system offers digitizing on-line camera

A document-scanning and communications system features a digital-camera resolution of up to 300 points/in. The PC Image/Graphix uses IBM Corp. Personal Computers and their compatibles for automated image digitizing and processing as well as for storage and forwarding capabilities in information networks. Media that can be scanned by the camera system include microfilm, photographs, three-dimensional objects, line drawings, and text. Once scanned, the data can be transmitted to remote printers or display terminals, or to an IBM or Digital Equipment Corp. host computer.

Software options include gray-scale halftone imaging, translation and rotation of the image, and formatting and compression. Systems software integration is available as an option.

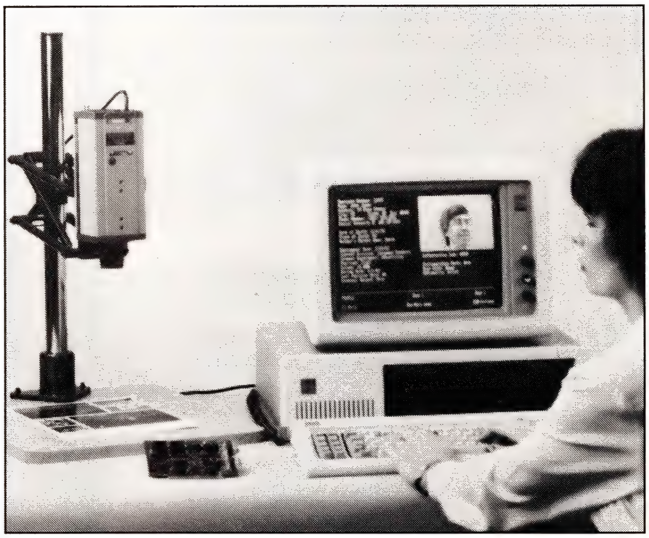
A basic PC Image/Graphix system includes a high-resolution camera-digitizer, image- and text-processing software, a cathode-ray-tube display, and a graphics printer; there are also options for network communications. Base prices start at $5,000, and deliveries will be made in 30 to 60 days.

Computer Systems, 26401 Harper Ave., St. Clair Shores, Mich. 48081. Phone (313) 779-8700 [Circle 349]

Board switches IBM monitor from color to monochrome

Users of the IBM 5153 color monitor or its equivalent will be able to use ScreenMaster to switch their usual color operation to a monochrome display capable of 16 true shades of gray. ScreenMaster, a half-width board compatible with the IBM Corp. Personal-Computer bus, sits between the monitor and the graphics display. From this position, it permits mode switching to be handled manually or under program control.

Using ScreenMaster and the Tecmar Graphics Master with Chorus PC-Eye and PhotoBase software, the user can extend data-base management systems to include



cross-indexed "photo albums." ScreenMaster can be delivered in two to four weeks. It is priced at $195. According to the company, a stand-alone package version will be shipped in 60 days. PC-Eye bundled with PhotoBase is priced at $690.

Chorus Data Systems, P.O. Box 370, Merrimack, N.H. 03054.
Phone (603) 424-2900 [Circle 348]

Under-$100 modem gives OEMs design solution

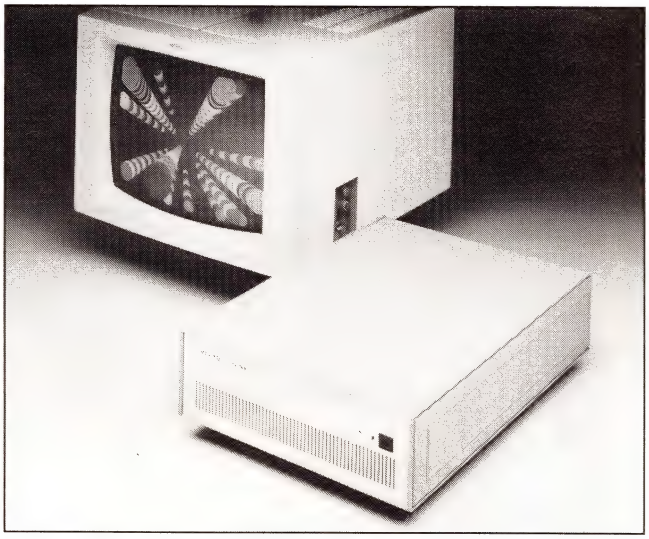
Priced as low as $99 in quantities for original-equipment manufacturers, the CH1770 is an intelligent Bell 212A-compatible modem. At 8 in.^{2}, it is designed for mounting on the host's printed-circuit board, where it can be integrated into terminals, voice and data work stations, microcomputers, test and measurement instruments, and other systems that need remote data transmission.

The CH1770 transmits data at rates of 110, 300, or 1,200 baud. Its features include auto-dial/auto-answer, tone or pulse dialing, auto-speed and auto-parity adjustment, and built-in diagnostics. The modem provides RS-232-C lines to the host at TTL levels and tip and ring signals for the telephone interface.

Cermetek Electronics Inc., 1398 Borregas Ave., Sunnyvale, Calif. 94088. Phone (408) 752-5011 [Circle 350]

Three processors make controllers fast on the draw

Adherence to the virtual device interface standard, the use of display-list memory, and reduced communication flow between host and controller mark Metheus Corp.'s latest color graphics controllers, the Ω2300, Ω2400, and Ω2500. The controllers are targeted at original-equipment manufacturers for such high-performance applications as computer-aided design, graphic arts, animation, computer imaging, and simulation.



The controllers count on the support of three processors: a 68000-based front-end processor; the data-base-bearing capacity of the custom-designed bit-slice processor based on Advanced Micro Devices Inc.'s 2900 bit-slice processor; and a specialized transform processor built around National Semiconductor Corp.'s 16032 processor.

To simplify building and transporting graphics applications, the Ω2000 series instruction set and Metheus-supplied graphics-library software provide a virtual device interface, which supports abstractions of the Graphics Kernel System and Siggraph Core graphics standards. The controllers' multiwindow display environment and local control of graphics cursors further support advanced user-interface techniques.

Display performance is increased by using the Ω2000-series display-list memory and transform processor. Display-list memory can store components of an image as a hierarchical graphics data base. Then these components are displayed with appropriate location, rotation, scaling, color, and other attributes whenever the display is to be redrawn. Only a few instructions are needed to modify the image, so the demands made on data-communication rates between the host computer and the display subsystem are reduced.

The Ω2300 and Ω2400 provide a color image with a 1,024-by-1,024-pixel resolution. The Ω2300 displays 16 colors from a palette of 16.7 million using four bit planes. The Ω2400 displays 256 colors at a time from the same-sized palette using eight bit planes. Drawing is done at a rate of 1 million pixels/s.

The Ω2500 has a 1,280-by-1,024-pixel resolution and can display 256 colors. Pixel memory can be folded into an alternative configuration that provides a 640-by-512-pixel resolution and 32 bit planes so that the full gamut of 16.7 million colors is available. Both Ω2500 models draw 1.5 million pixels/s.

Available now, the Ω2300 sells for $10,950, the Ω2400 for $13,950, and the Ω2500 for $17,950.

Metheus Corp., P.O. Box 1049, Hillsboro, Ore., 97123.
Phone (503) 640-8000 [Circle 379]

Single-user work stations offer 19-in. color monitor

The Aria line of single-user engineering work stations has been enlarged to include a 19-in. color monitor; when Aria was introduced last October, only a 13-in. color monitor was available. These work stations include a 32-bit processor, virtual-memory architecture, and full color graphics display. Software for the Aria line is Bravo!—for two- and three-dimensional design and drafting. The work stations also run a number of third-party programs.

Optional features that the buyer can add to the work station are Ethernet, a cartridge tape drive, additional memory and a hardware floating-point accelerator in one package, and both RS-232-C communications with peripherals and remote DECnet communications capability. Available now, the Aria color engineering work station with 13- or 19-in. monitor is $90,000.

Applicon, 32 Second Ave., Burlington, Mass. 01803.
Phone (617) 272-7070 [Circle 351]

VLSI is the secret of interactive work station

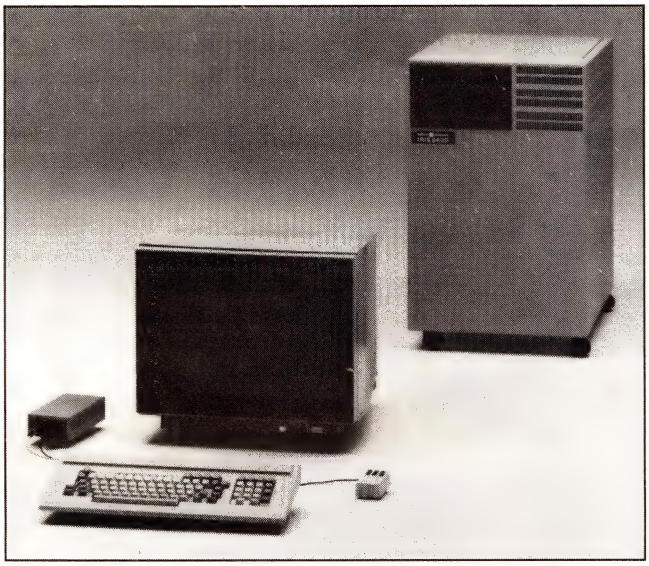
With the Iris 2400, an engineering work station, users do not have to make tradeoffs between high-performance computing and advanced graphics. The work station is suitable for three-dimensional solids modeling, molecular modeling, circuit design and layout, and architectural engineering and plant design, among others.

The heart of the work station is a pipelined array of 10 or 12 proprietary Geometry Engines—custom very large-scale-integration processors—that work with 32-bit floating-point geometric data defined in virtual "world" space. In addition to manipulating data at speed, the Geometry Engines perform such operations as smooth-surface (Gouraud) shading at up to 3 million pixels/s, hidden-surface removal, and object-interference detection.

The central processing unit is an MC68010 chip running at 10 MHz. The Iris 2400 runs on Unix V with Berkeley 4.2 enhancements; C language and the Iris graphics library are standard. Fortran and Pascal compilers are also available. The work station can perform as a stand-alone unit or as a node in a distributed network by means of Ethernet.

The display resolution is 1,024 by 1,024 (1,024 by 768 viewable 60-Hz noninterlaced). A National Television Standards Committee RS-170A output allows broadcast-quality video tapes to be generated from digitally created color graphics. The Iris 2400 work station lists for $49,500. The model 2500, with a 440-megabyte disk, is priced at $76,500. Initial shipments have begun.

Silicon Graphics Inc., 2674 N. First St., San Jose, Calif. 95134.
Phone (408) 946-1400 [Circle 378]



Single board puts Forth kernel on the STD bus

Based on the Rockwell 65F11 Forth chip, ForthCard, a single-board computer, can be interfaced to most STD-bus-compatible memory and input/output boards. It can also run as a stand-alone computer with an optional 5-V on-card regulator. The ForthCard possesses 16 I/O lines, which can be configured in serial or parallel, as interrupt inputs or timer-counter I/O bits. Memory can be expanded by means of three 28-pin sockets, which will accommodate most byte-wide memories. An on-board programming capability works with the optional development read-only memory to develop firmware.

ForthCard will find its greatest use in dedicated functions such as control or data acquisition, the manufacturer says. For example, simple analog I/O can be performed using the pulse-width modulated output from one of the two 16-bit counter-timers.

The original-equipment-manufacturer version of ForthCard, model STD65F11-00, without memory devices or manuals, is priced at $299 in quantities of 10 to 25. The development (STD65F11-02) version, which includes the card, development read-only memory, an 8-K-byte random-access memory, a 2-K-byte electrically erasable programmable ROM, and 300-page manual, has a single-unit price of $499. Both are available from stock.

HiTech Equipment Corp., 9560 Black Mountain Rd., San Diego, Calif. 92126. Phone (619) 566-1892 [Circle 352]

Data-acquisition board serves IBM PCs

Designed for the IBM Corp. Personal Computer, Adalab-PC, a plug-in data-acquisition board, includes a 13-bit integrating analog-to-digital converter for slow voltage sampling, a 12-bit successive-approximation ADC for fast voltage sampling, and two 12-bit DAC for voltage output. Multiple jumper-selectable voltage ranges are provided for each ADC and DAC.

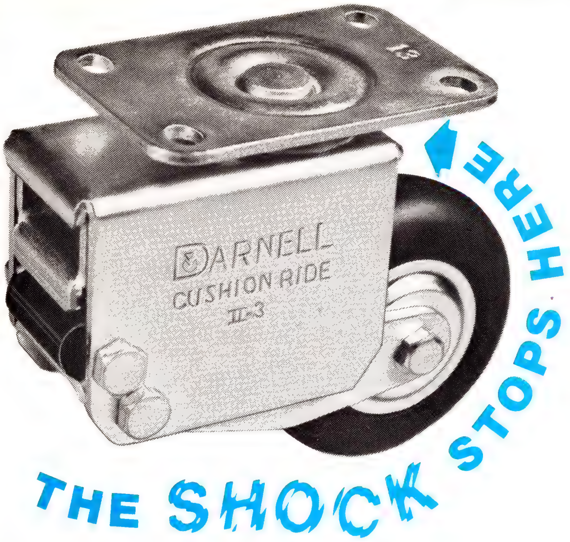
Adapt software, included with the board, runs in Basic, compiled Basic, Fortran, or Pascal. With Adapt, the user can collect multiple-data values, perform fast A-D voltage sampling with direct memory access, and store and retrieve data from up to 640-K bytes of extended random-access memory.

The Adalab-PC board including Adapt software is available now for $895. An extended 16-channel differential analog multiplexer with programmable gains from 1 to 256 is also available for $300.

Interactive Microware Inc., P.O. Box 139, State College, Pa. 16804. Phone (814) 238-8294 [Circle 354]

DMA interface for Q bus passes 250-K bytes in 1 s

The DRV11-WA, a direct-memory-access interface that handles 16-bit data word exchange over the extended Q-bus, is designed to work with the PDP-11/23-Plus, MicroPDP-11/73, and MicroPDP11 systems. It is back-



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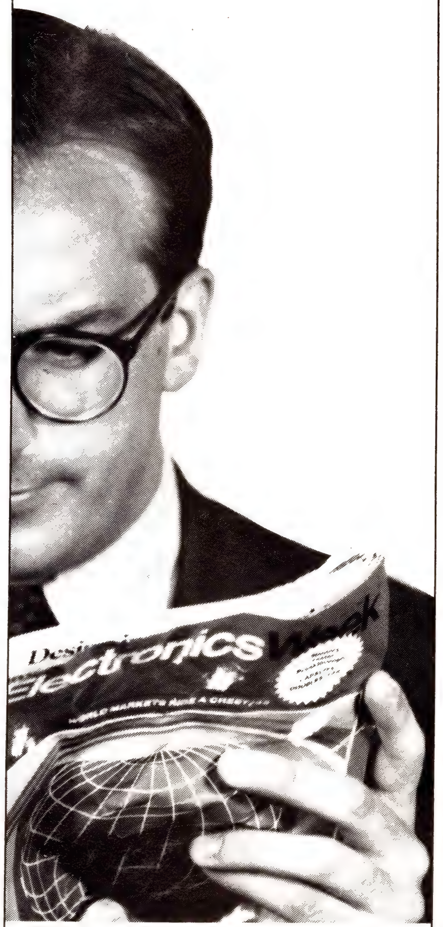

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- low forward voltage drop.

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ultra-fast free wheel diode
t_{rr}: from 25 to 50 ns max.
V_F/I_O = 1.4 V

$I_{F(AV)}$	CASE TYPE	NON INSULATED CASE	INSULATED CASE
1 A	F 126	BYT 01	
3 A	DO 27	BYT 03	
8 A	DO 220	BYT 08 P	BYT 08 PI*
12 A	DO 4	BYT 12	
16 A (2 x 8)	TO 220	BYT 16 P	
30 A	DO 5 DOP 3	BYT 30 BYT 30 P	BYT 30 PI*
60 A	DO 5 DOP 3	BYT 60 BYT 60 P	
60 A (2 x 30)	ISOTOP		BYT 230 PI*

*Insulating voltage: 2500 VRMS

V_{RRM} = 600, 800 V
ultra-fast free wheel diode
t_{rr} max. ⩽ 60 ns
V_F/I_O = 1.7 V

$I_{F(AV)}$	CASE TYPE	NON INSULATED CASE	INSULATED CASE
12 A	DO 4 DO 220	BYT 12 BYT 12 P	**BYT 12 PI***
30 A	DO 5 DOP 3	**BYT 30** BYT 30 P	**BYT 30 PI***
60 A (2 x 30)	ISOTOP		**BYT 230 PI***

*Insulating voltage: 2500 VRMS

V_{RRM} = 1000 V
ultra-fast free wheel diode
t_{rr} max. ⩽ 70 ns
V_F/I_O = 1.8 V

$I_{F(AV)}$	CASE TYPE	NON INSULATED CASE	INSULATED CASE
12 A	DO 4 DO 220	**BYT 12** **BYT 12 P**	**BYT 12 PI***
30 A	DO 5 DOP 3	**BYT 30** **BYT 30 P**	**BYT 30 PI***
60 A (2 x 30)	ISOTOP		**BYT 230 PI***

*Insulating voltage: 2500 VRMS

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- low forward recovery time, t_{fr}: from 10 to 20 ns.

V_{RRM} = 50, 100, 150, 200 V
t_{rr}: from 25 to 50 ns max.
V_F/I_O = 0.85 V

$I_{F(AV)}$	CASE TYPE	NON INSULATED CASE	INSULATED CASE
1 A	F 126	BYW 100	
3 A	DO 27	BYW 98	
7 A	DO 220	BYW 80	
15 A	DO 4 DO 220	BYW 81 **BYW 81 P**	**BYW 81 PI***
20 A (2 x 10)	TO 220	BYW 51	
25 A	DO 4 DOP 3	BYW 77 **BYW 77 P**	**BYW 77 PI***
30 A (2 x 15)	TOP 3	**BYW 99 P**	
35 A	DO 5	BYW 92	
50 A	DO 5	BYW 78	
60 A (2 x 30)	TOP 3	BYV 52	
80 A	DO 5	BYW 08	
100 A (2 x 50)	ISOTOP		BYV 54*

*Insulating voltage: 2500 VRMS

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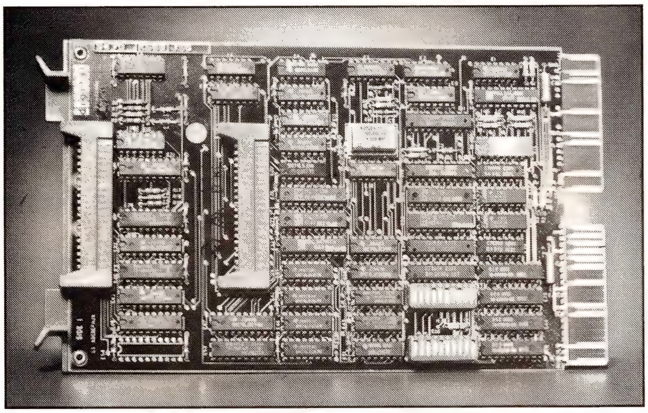


ward-compatible with its predecessor, the DRV11-B.

The unit features speeds up to 250-K bytes/s in single-cycle mode and double that in burst mode. In typical applications, the DRV-11WA can interface high-speed graphics terminals, data-acquisition devices, and machine-tool controls. It functions in seismic-data collection and spacecraft launch telemetry.

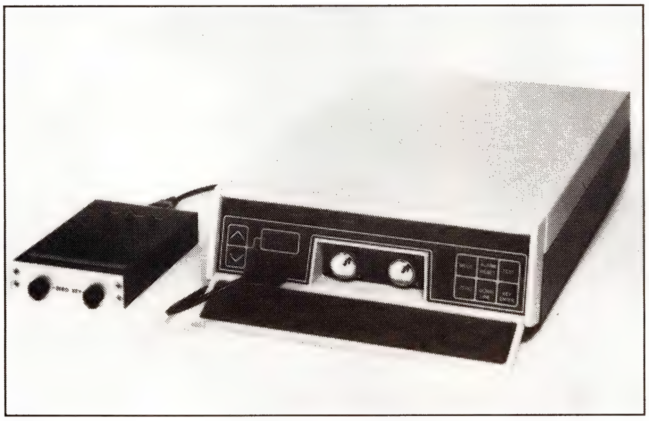
Priced at $850, the DRV11-WA interface is available with volume discounts. The products are being shipped 30 days after receipt of the order.

Digital Equipment Corp., 129 Parker St., Maynard, Mass. 01754. Phone (617) 493-5489 [Circle 353]

Scrambled data foils unauthorized parties

Designed to meet FED-STD 1027, the Cipher X 5000 digital communications security system protects information by rendering it unintelligible to unauthorized data seekers. The company calls Cipher X 5000 user-friendly and says it was designed with the system manager and security officer in mind. Capable of accommodating multiple keystroke management techniques, this system secures dedicated, dial-up, point-to-point, and multidrop networks in a number of configurations. Prices for the Cipher X 5000 start at about $3,000, and delivery takes from 90 to 120 days. Both price and delivery time depend on the quantity ordered and configuration desired.

Technical Communications Corp., 100 Domino Dr., Concord, Mass. 01742. Phone (617) 862-6035. [Circle 361]



Security software for IBM PC has audit capability

Offering multilevel password access and automatic audit capabilities, the Computer Intelligence Access software's encryption algorithm is derived from the Data Encryption Standard of the federal government. The security software also includes a protection system that prevents any user from erasing or deleting a file, and the maintenance system is accessible only to the system administrator. The program requires 256-K bytes of random-access memory to run.

Computer Intelligence Access software is available for the IBM Corp. Personal Computer XT and compatibles. Priced at $300, it will be shipped in 10 days to two weeks after receipt of order.

General Data Security Systems Inc., 1127 Loma Ave., Long Beach, Calif. 90804. Phone (213) 494-1127 [Circle 360]

Instrument boosts ac measurement capabilities

Combining the characteristics of a sophisticated ac digital voltmeter and a waveform analyzer, a new type of instrument, the digital analyzing voltmeter, is designed for ac measurement. But the model 2250's measurements eliminate the errors that can be encountered with digital voltmeters in certain types of ac measurements.

The 68000-based instrument offers such features as fully isolated inputs, self calibration, wideband frequency response of 10 Hz to 100 kHz, typical phase-angle accuracy of 0.05°, harmonic analysis, a built-in IEEE-488 interface bus, an LED analog null meter, and automatic frequency sensing and autoranging.

It uses fast Fourier transform techniques to provide the traditional capabilities of total, fundamental, in-phase, and quadrature voltage and phase-angle measurement. High-accuracy ratio measurements can also be made, in both phase-sensitive and total modes.

The 2250 can measure the percent of a signal's total harmonic distortion as well as the magnitude and phase of a selected harmonic. It can also compute a signal's deviation from a selected nominal value. The signal's magnitude can be displayed in decibels relative to either the reference input or a selected value.

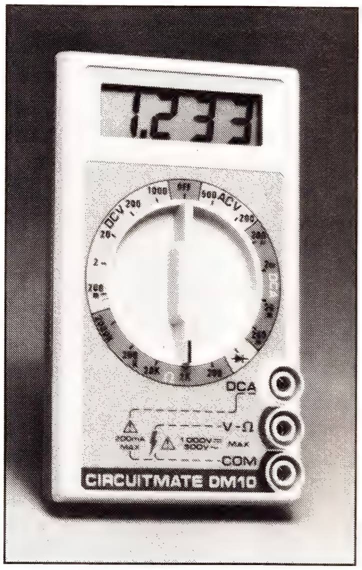
Available in 90 days, the 2250 digital analyzing voltmeter sells for $9,750.

North Atlantic Industries Inc., 60 Plant Ave., Hauppauge, N.Y. 11788. Phone (516) 582-6500 [Circle 377]

Small 3½-digit multimeter sells for $39

About the size of a pocket calculator, the DM10 3½-digit multimeter has a rotary switch, displays ½-in. high digits on its LCD, and covers five dc-voltage ranges from 200 mV to 1 kV. It provides overload protection to 1 kV dc in all ranges above 200 mV and to 500 V dc for the 200-mV range; in ac voltages, the ranges of the meter extend from 200 V to 500 V, with overload protection in all ranges to 500 V.

The meter has five resistance ranges covering 200, 2,000, 20,000, 200,000, and 2 million Ω with overload protection to 250 V ac and dc. The DM10 also has a diode test function.



Its dc current ranges are 200 μA, and 2, 20, and 200 mA, all protected by a 0.8-A, 250-V fuse. Test leads are included with the meter, which sells for $39. It is available from stock.

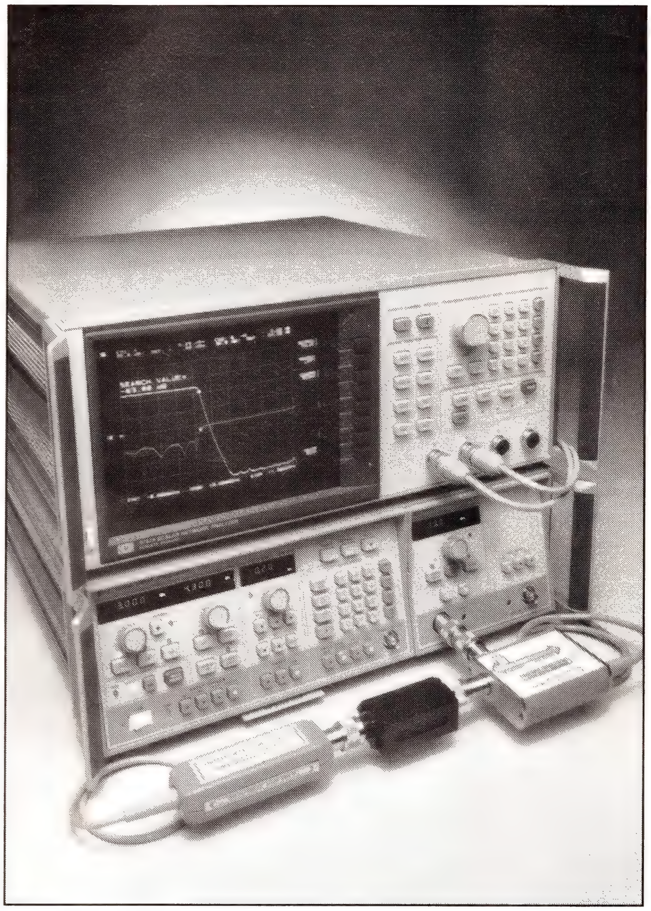
Beckman Industrial Corp., 630 Puente St., Brea, Calif. 92621. Phone (714) 773-8436 [Circle 363]

Scalar network analyzer handles 40-GHz frequencies

Combined with a swept-frequency signal source, microwave bridge, and detectors, the HP 8757A scalar network analyzer measures transmission and return loss from 10 MHz to 26.5 GHz in coaxial cable and to 40 GHz in waveguide (with provisions for higher frequencies). The analyzer's detectors measure both modulated (ac) and unmodulated (dc) signals, so the user can choose the best format for the measurement application.

The instrument, which can measure interactive responses of such multiport gear as multiplexers and dividers, boasts a 76-dB measurement dynamic range for all channels (three are standard, a fourth is optional). Its 9-in. CRT can display up to four annotated traces. A single trace can have as many as 1,601 points; even with four traces, 401 points per trace of data can be displayed.

Modulated signals usually permit greater dynamic range and faster sweeps. Modulation also can overcome such interfering signals as radio-frequency interference, broadband noise, or (in the case of mixer testing) local oscillator feedthrough.



Applications where dc detection of unmodulated signals may be preferable include gain measurements on duty-cycle-sensitive traveling-wave amplifiers and amps with fast automatic-leveling capabilities. With dc detection, the absolute power output from amps and oscillators can be measured with precision typically better than ±0.5 dB.

The basic instrument sells for $11,000 and takes six weeks for delivery. Detectors range from $430 to $950 and bridges range from $2,500 to $2,800 each.

Hewlett-Packard Co., Inquiries Manager, 1820 Embarcadero Rd., Palo Alto, Calif. 94303 [Circle 362]

Middle-range unit bolsters VS office-computer line

The latest addition to the VS series of computers, the VS 65 fills in the middle range. Wang's VS series of computers serves the firm's strategy of integrating data processing, communications, and office automation. A package configuration of the VS 65 consists of the central processing unit supported by 1 megabyte of memory, a 5¼-in. 360-K-byte disk drive, an internal 147-megabyte hard-disk drive, remote diagnostics, and Wang's operating system.

The 32-bit CPU, which has architecture for parallel

processing, has a 200-ns instruction time, a fast cache memory, and a full 32-bit data path. Input/output processing is off-loaded to an 80286 microprocessor.

Software supported includes several VS/IIS options, such as Charter graphics software or list management, and WP Plus, Wang's text editor. The VS 65 also supports VS windowing software, the VS graphics facility, and integrated image processing through the Wang PIC image processing system.

A data-storage cabinet with a 147-megabyte hard-disk drive and a 76-megabyte removable disk drive, a two-port disk controller, two 15-ft cables, and four 4230-VS work stations rounds out the package, which is sold for \$54,300. The basic CPU alone sells for \$19,000. Shipment of VS 65 systems will start this month.

Wang Laboratories Inc., 1 Industrial Ave., Lowell, Mass. 01851.
Phone (617) 459-5000 [Circle 364]

Scientific computer sustains 38 megaflops

A 64-bit scientific computer, the FPS-264 boasts a peak processing speed of 38 million floating-point operations/s and a main memory of up to 4.5 million words (about 36 megabytes). Special optional hardware accelerators further increase processing speeds (up to 341 megaflops) for applications using complex matrix algebra.

All applications software currently being used on the company's earlier model, the FPS-164, will also run on the FPS-264. Targeted at universities, research centers, government, and industry, the computer will find applications in structural analysis, computational chemistry, electronic circuit design, computational physics, and reservoir simulation.

The company feels the computer fits in a wide gap between supercomputers and superminicomputers, according to Lloyd D. Turner, president and chief executive officer of Floating Point Systems Inc. "An FPS-264 will run most problems in the range of 10 to 50 times as fast as the leading superminicomputer, at a cost of only about two to three times as much. On the other end of the spectrum, the FPS-264 can provide about half the performance of the most popular supercomputer but at less then one tenth the price."

The FPS-264 employs custom ECL gate arrays for increased processing speed, variable interleave for faster access to memory, and extensive diagnostics. Other technologies used to improve the FPS-264 include parallel processing, in which calculations are made by multiple processors acting simultaneously; pipelining, in which data to be processed is delivered more efficiently; and a larger memory.

The FPS-264 employs eight pipelined data paths, connected by seven high-speed, protected buses.

The computer is programmed in Fortran 77; the computer is supplied with a Fortran compiler, overlay linker, and the System Job Executive, the company's proprietary operating system. A large number of third-party programs for scientific and engineering applications, including Ansys and MSC/Nastran for structural analysis and several versions of Spice for electronic-circuit design, have been adapted by their vendors for the FPS-264.

Prices for the FPS-264 start at \$640,000; delivery will begin in the third quarter.

Floating Point Systems Inc., 3601 S.W. Murray Blvd., Beaverton, Ore. 97005. Phone (503) 641-3151 [Circle 381]

Voice-recognition system boasts 32,000 words

A dedicated voice-recognition system supports 32,000 words in storable and switchable vocabularies of up to 500 words each. Each word in a given application's vocabulary can invoke user-defined macro commands of up to 1,000 character keystrokes. The system operates in real time with a voice-transfer rate of 200 ms.

Voicecraft operates on the IBM Corp. Personal Computer and PC/XT, Logical's L-XT, and other compatibles with 128-K bytes or more of random-access memory. It runs on all IBM PC software progams without any modifications. The easy-to-install system comes with a full-plug-in board and three microphones. Voicecraft, available now from the company and its distributors, sells for \$895.

Logical Business Machines, 1294 Hammerwood Ave., Sunnyvale, Calif. 94089. Phone (408) 737-1911 [Circle 358]

SOFTWARE

Software increases speed of access operations

Depending on system size and applications being used, Fastware TMS 3.0 reduces memory access time as much as a hundredfold. The software reserves an area of system random-access memory for disk caching and print buffering, freeing computer time for other tasks. The utility software, which also cuts hard-to-floppy-disk back-up time in half, uses as little as 16-K of RAM.

Compatible with such standard microcomputers as those from IBM and AT&T, Fastware TMS 3.0 is transparent to MS-DOS. Installation requires no changes in hardware, software, or user operations.

The software sells for $60 and is available for shipment.

Thesys Memory Products Corp., 7345 E. Acoma Dr., Scottsdale, Ariz. 85260.
Phone (602) 991-7356 [Circle 356]

Assembler supports Intel's 16-bit microprocessors

A re-release of Micro Assembler supports Intel's 80 series of 16-bit microprocessors and offers an extensive set of development utilities. The new release works with the 80186, 80286, and 80287 instruction sets as well as with the 8086, 8087, and 8088 microprocessors supported by the previous version.

Among the assembler's new features is a symbolic debug utility that significantly speeds the debugging process. The utility displays source-code lines, so that programmers can examine and step through both their source and their object codes. The other important addition to the software is a maintenance-utility program called Make, which automatically updates a program after any of its source files has been changed. Both the debugging and maintenance utilities work in all the company's high-level languages.

The development-tools package is an updated version of the previous release. Among the improved features are the object linker, which now allows programmers to use multiple overlay; the library manager, which now features variable page siz-

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ElectronicsWeek
Special Report: April 8

Surface Mountable Components

Now that component placement machines and special soldering systems are available, only one roadblock still exists in the burgeoning SMD field—surface mountable components.

This Special Report will tell what's available, what's missing, what's coming in surface mountable resistors, capacitors, inductors, switches, relays, sockets, connectors and others.

It will include companies such as Philips SMD Technology Service Center, Allen Bradly, Kyocera, Amp, Burndy, Berg, Panasonic, TI, Moto, National Semi, Signetics, AVX, Murata Erie, Mepco-Electra, Rohm, Kemet, Sprague, Harris Semi and others.

Issue Date:
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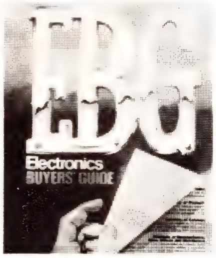

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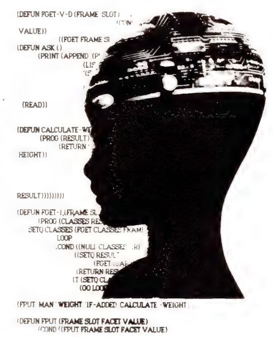
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Circle 91 on reader service card

ing; and the cross-reference utility for listing the definitions and locations of all symbols used in the assembly-language program.

The Macro Assembler is available now from the company's retail outlets. The assembler lists at $150, but owners of the earlier release can upgrade it for a nominal fee.

Microsoft Corp., Box 97200, Bellevue, Wash. 98009.
Phone (206) 828-8080 [Circle 357]

Materials-planning software for low-end manufacturers

The E-Z-MRP system brings material-requirements planning to microcomputers. By simplifying the input required by the system, the software offers materials planning to small- and medium-sized firms that don't have mainframe computers.

The E-Z-MRP system centers on the BMP (Bill of Materials Plus) package. The BMP can serve independently as a parts file; the default column headings are simple and recognizable but can also be defined by the user. In standard systems for material-requirements planning, the bill of materials is supported by a number of subsystems, such as purchasing, inventory, and order entry. But the E-Z-MRP system centralizes these subsystems and depends on demand-side factors—such as orders—to schedule production.

Training an operator and keying in the data base requires 30 days. Though the system was designed to operate on a single-user machine, it also operates on a network.

The E-Z-MRP and BMP programs sell for $1,495 and $995, respectively. They are also available as a package for $2,490. Demo systems are also available.

C.R. Smolin, Inc., 5230 Carroll Canyon Rd., Suite 206, San Diego, Calif. 92121. Phone (619) 455-1285 [Circle 359]

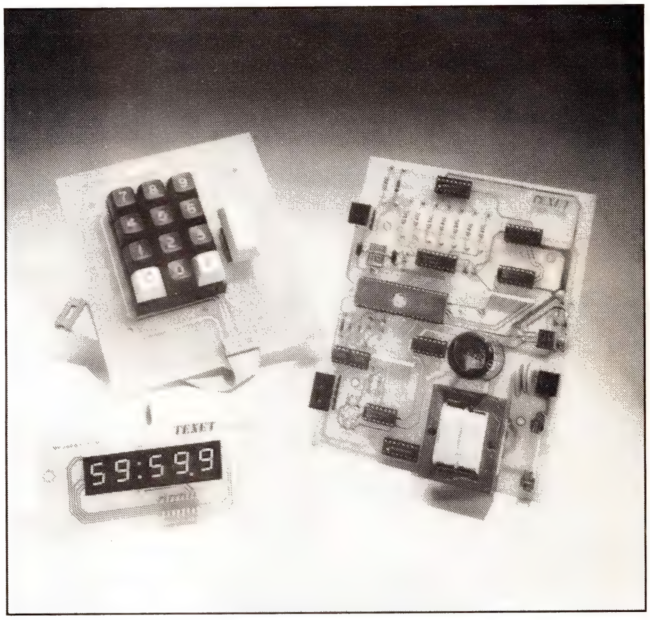
Microprocessor-based timer can be set from 0.1 s to 1 h

An electronic five-digit timer boasts 0.1-s resolution and ±0.005% accuracy. Operating in temperatures from 0°C to 60°C with a 120-V ac input, the TMR-60 uses a microprocessor and keyboard to control timing functions.

An EPROM offers flexibility for custom timing operations, while the unit's crystal-controlled time base provides accuracy and temperature stability. Designed with the original-equipment manufacturer in mind, the TMR-60 has a timing range of 0.1 s to 60 min, with red ½-in. LEDs indicating minutes, seconds, and tenths of a second.

The module provides three outputs. Each output is designed to drive a small relay or an optocoupler, and each can be programmed independently for flexibility in controlling operations. The TMR-60's keyboard has 13 full-travel keys, two-tone audio feedback, and an entry key for repeating the last time setting.

The module can be provided in a modular configuration with separate keypad and display or as a complete, ready-to-plug-in stand-alone unit. Priced at $350 each, the TMR-60 is available now in limited quantities from stock.

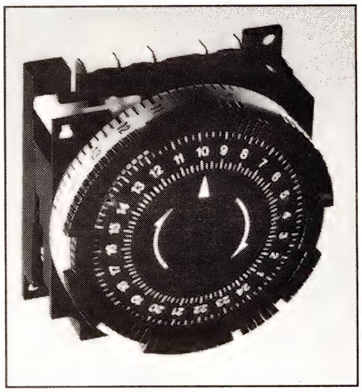


V.N.H. Industries Inc., 3055 Brighton-Henrietta Town Line Rd., Rochester, N.Y. 14623. Phone (716) 427-8050 [Circle 374]

Compact time switches are accurate to 1 s per day

A line of programmable time switches for original-equipment manufacturer applications in appliances, industrial equipment, and control panels requires only a ⅞-in. depth for mounting in control panels or other housings. The overall size of the individual switches is only 2.4 in.^{2} by 0.8 in. deep, with a diameter of 2.5 in.

Designated the Group 880 line, the switches provide accurate switching times and offer a number of easy-to-set programs. In a 24-h version, the 880 switch is available with 96 settings of 15-min durations, and a seven-day model allows 84 settings of 2-h durations. Resistive switching capability is 15 A at 240 V.



The programmable time switches are available with either a synchronous clock motor or a quartz-driven step motor. The quartz motor is powered by an automatically rechargeable nickel cadmium battery that provides up to 120 h of operation at 68°F and is accurate to within 1 s per day.

Borg Instruments Inc., Diehl Time Controls Division, 902 Wisconsin St., Delavan, Wis. 53115. Phone (414) 728-5531 [Circle 373]

Unit programs and tests arrays in under 2 s

Dedicated to programmable logic devices, the portable models 60A and 60H combine simple, menu-driven operating protocols with programming and testing that take less than two seconds. Each unit programs more than 125 devices—over 99% of those available, the company claims.

A multiuser tool for prototyping in the engineering lab, the model 60A programs devices inserted manually into a socket. Designers can use the 60A, together with a personal computer and logic design software (like the company's own Abel), as a complete design and programming station. The 60H combines the capabilities of the 60A with a software and hardware interface to an automatic device handler.

For testing, the programmers use the company's Logic Fingerprint, which provides both array verification and functional testing. The Logic Fingerprint is a functional test that uses one or more cycles of 128,000 pseudorandom test vectors to simulate the part's operation.

A 60A version that programs both programmable logic arrays and integrated fuse logic sells for $3,425. A PLA-only version goes for $3,150, and a model for just integrated fuse logic sells for $3,275. Delivery takes about two weeks. The 60H model sells for $4,425, with delivery in 12 weeks.

Data I/O Corp., 10525 Willows Rd. N.E., Redmond, Wash. 98073.
Phone (206) 881-6444 [Circle 380]

Connector is filtered without increase in size

A filtered D-subminiature connector retains the same size as unfiltered connectors and is interchangeable with conventional versions. The filtered connector brings a system's electromagnetic-interference emission levels in line with those set by the Federal Communications Commission.

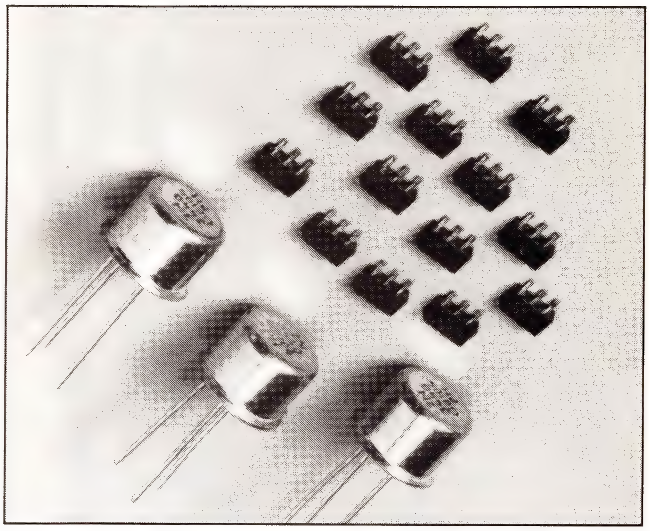
It also minimizes the electromagnetic susceptibility to electrostatic discharge, system noise, and asynchronous noise at the I/O equipment. The new connector can be used without any physical modification of existing equipment. Price and delivery information were unavailable at press time.

Eby Co., 2751 Southampton Rd., Philadelphia, Pa. 19154.
Phone (215) 969-4200 [Circle 369]

Telecom chips now come in surface-mountable packages

Two industry-standard telephone exchange switching transistors are now available in surface-mountable packages. The BST39 and BST40, each in an SOT-89 package, have the same performance data as the conventional high-voltage 2N3439 and 2N3440 devices housed in metal cans.

An improvement on the conventional transistors is that the crystals are passivated with silicon nitride for extra stability. With collector-emitter voltage ratings of 350 V for the BST39 and 250 V for the BST40, the devices are suitable not only for use in telephone exchange-switching applications but also in general high-voltage industrial switching circuits. They are intended mainly for thick- or thin-film substrates for hybrid circuits. Samples are available now.



Amperex Electronic Corp., George Washington Hwy., Smithfield, R.I. 02917 [Circle 366]

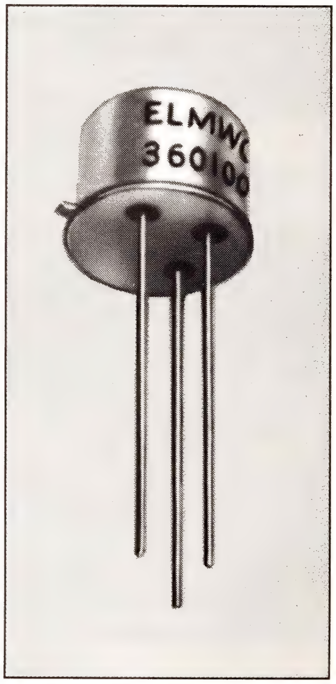
Thermal switch monitors a pc board's temperature

Mountable directly onto a printed-circuit board, a thermal switch monitors the ambient temperature around the board. The 3601 thermal switch can also be mounted on a heat sink for individual component thermal control. In addition, the thermal device functions as an alarm switch to alert the operator of a problem.

The 3601 is packaged in a standard hermetically sealed TO-5 can. The switch is thus protected during the circuit-board cleaning operations that precede wave soldering.

Because of the TO-5 can's low profile, the 3601 shares the same height as the surrounding components. This allows it to be automatically inserted on the circuit board, along with the other parts, without sacrificing significant board real estate.

The 3601 features a single-pole, single-throw,



thermally operated snap-action switch designed for dry, low-power, and logic-level circuits.

The 3601 thermal switches are available from stock in temperature settings ranging from 40°C to 100°C in nominal 5°C increments. Pricing was unavailable at press time.

Elmwood Sensors Inc., 500 Narragansett Park Dr., Pawtucket, R.I. 02861. Phone (401) 727-1300 [Circle 367]

Surge arrestors fire faster than gas surge tubes

Approved by Underwriters Laboratories for use in power supplies for computers and other digital and analog electronic systems, the DAS/2 series of high-voltage surge-arrestor tubes absorb high-voltage spikes or surges induced on power lines by lightning strikes or switching transients. The DAS gas surge tubes are characterized by a resistance film-coated ceramic spacer between the two metal electrodes.

A series of very small grooves are cut through this resistive coating with a laser system to control the firing voltage—1,000, 1,500, 2,400 or 3,000 V. During a voltage spike, a true field emission discharge is created across the narrow gaps as a result of the high electric field strength, and the resistive coating forces the discharge to jump to the metal electrodes as current increases toward the arc mode.

The company claims that this mechanism lets the DAS series fire about three times as fast as conventional gas surge tubes. Moreover, this speed is maintained even in the absence of ambient light, when standard tubes slow down in firing due to the so-called dark effect.

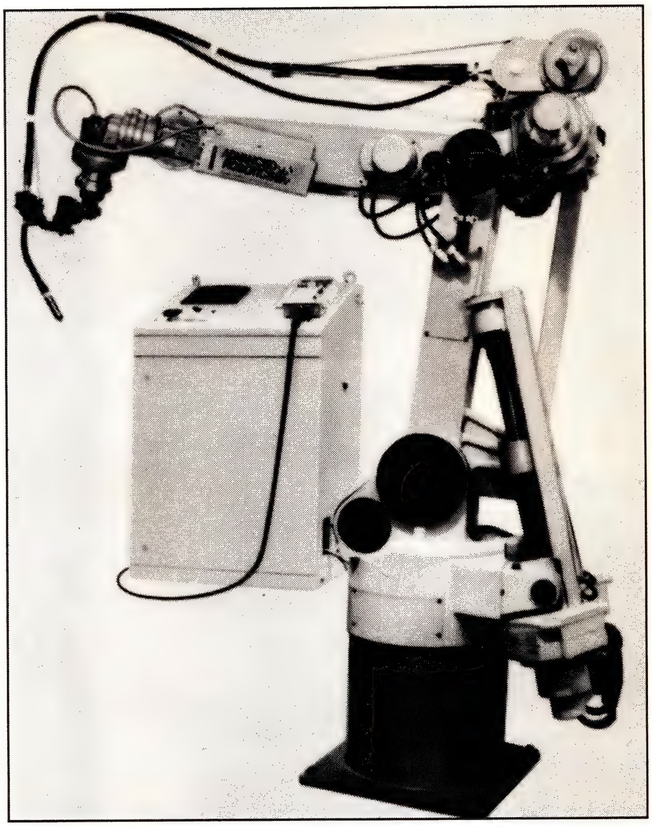
The DAS tubes, priced typically at 50¢ each in large quantities, require only a 3-Ω series limiting resistor to handle spikes with voltages over 10 kV and energy levels over 100 J.

Mitsubishi International Corp., Hi-Tech Components Division, 520 Madison Ave., New York, N.Y. 10022.
Phone (212) 605-2607 [Circle 368]

Sixth axis lets robot weld hard-to-reach joints

A six-axis robotic arm work cell allows continuous welds on complex joint profiles. The sixth axis of the Cyro 1000 articulated arm robot eliminates the need for special torches or brackets that were previously required to achieve the proper welding angle in many applications. With the sixth axis, the proper torch attitude can be maintained even while welding complex joint profiles.

The Cyro 1000 reduces or eliminates the need for an indexing table or multiple-axis positioner by providing more robot dexterity. This reduces the work-cell cost while providing maximum joint accessibility. The robot has a maximum carrying capacity of 22 lb; its working envelope is 1,400 mm, and the robot's six-axis offset wrist design provides a larger range of movement within that radius.



The basic Cyro 1000 work cell includes a Cyro 1000 robot, a C-30 controller, a welding process package, a machined steel base that supports dual platen tables, and a welding screen. The robot is available in two weeks.

Advanced Robotics Corp., 777 Manor Park Dr., Columbus, Ohio 43228. Phone (614) 870-7778 [Circle 365]

Four-point probe measures 650 points on a wafer

Increased point capability distinguishes the Auto Map 280 sheet-resistivity wafer-mapping system. With four-point probing, it can map up to 650 points on a wafer, whereas systems with fewer points map around 200 points. The probe measures the sheet resistivity of ion-implanted layers on the wafer, which provides critical defect information for producers of integrated circuits. As the number of points increases, the probe is able to check the implantation in ever-greater detail.

The model 280 features autoranging from 0.01 to 2×10^3, 0.1 to 2×10^4, or 1 to 2×10^5 Ω-sq; one-point, five-point, or externally controlled measurements are also possible. External control is managed by interfacing to an IBM Corp. Personal Computer or a compatible through an RS-232-C port. The Auto Map 280 automatically compensates for the wafer-edge effect and probe-tip-distance variation. The Auto Map 280 will accept wafers between 2 in. and 6 in. in diameter.

A complete system, including the IBM PC, software, and printer, is $45,000, with delivery in eight weeks.

Four Dimensions Inc., 3138 Diablo Ave., Hayward, Calif. 94545.
Phone (415) 782-1843 [Circle 355]

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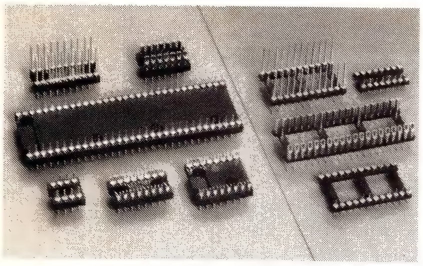

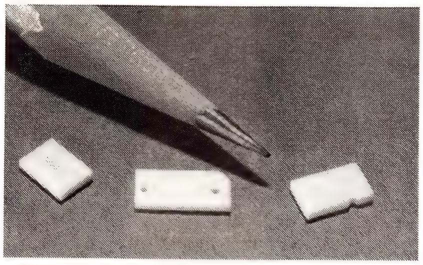

Sockets that extend 0.08 in. above the board come in 8 through 40 positions, with a choice of solder-tail or wrapped-wire termination with tin, gold, or tin-gold plating. The body material is glass-filled nylon. In hundreds, prices begin at 44¢.

Samtec Inc., P.O. Box 1147, New Albany, Ind. 47150. Phone (812) 944-6733 [Circle reader service number 421]

Instrument cases that attach to a 19-in. subrack and are compatible with IEC 297 come in four sizes. Cast aluminum bezels secured to side extrusions form the frame. The finish is textured electrostatic-powder epoxy paint in six colors and assorted front trims.

BICC-Vero Electronics Inc., 40 Lindeman Dr., Trumbull, Conn. 06611. Phone (203) 472-0038 [Circle 422]

Medical research is targeted by Superguide G, an all-silica fiber for transmission from 0.2 to 1.0 μm. Numerical apertures range from 0.1 to 0.22, and core dimensions range from 25 to 1,000 μm. Typical power densities are 1,000 W/mm^2 continuous wave and 1 MW/mm^2 pulsed. Superguide G fiber fits standard connectors.

Fiberguide Industries Inc., 33 Poplar Dr., Stirling, N.J. 07980. Phone (201) 647-6601 [Circle 423]

Braided sleeving for conductive or nonconductive use comes in tinned copper or polyester, with a factory-installed pull cord. The materials are flexible and provide a contour fit over otherwise loose wires of different sizes.

Wallentubing, 18314-4 Oxnard St., Tarzana, Calif. 91356. Phone (818) 345-9727 [Circle 425]

Wire guides for dot-matrix printers, in either alumina zirconia or Cermet, are said to have a minimum character life of 5 million characters. They feature a one-piece design and are available in 9-, 18-, and 24-hole models as well as in custom designs.

Kyocera International Inc., Computer Peripheral Products, 23181 Verdugo Dr., Suite 103-B, Laguna Hills, Calif. 92653. Phone (714) 472-9477 [Circle 426]

Fluorinert FC-5311 performs as the primary working fluid in vapor-phase soldering. Its thermal stability is said by the manufacturer to result in reduced levels of trace decomposition products, nearly eliminating corrosion problems.

3M Co., P.O. Box 33600, St. Paul, Minn. 55133. Phone (612) 736-9112 [Circle 433]

Spectra-Coax cable, a mass-terminating Spectra-Strip planar cable for high-signal-speed applications, consists of individual solid conductors, each with foamed polyolefin insulation, a foil shield, and a drain wire. The series 121 cable comes in up to 33 conductors and in 50-, 75-, and 93-Ω impedance versions.

Amphenol Products, 4300 Commerce Court, Lisle, Ill. 60532. Phone (800) 323-7299 [Circle 427]

A sandwich of a 2-mil adhesive with a glass-fiber filling that measures 1.4 mils thick is offered to manufacturers of fine-line Multiwire circuit boards for military and space applications. The manufacturer claims high uniformity and control of both thickness and stiffness for the adhesive layer.

Norwood Industries Inc., 100 N. Morehall Rd., Malvern, Pa. 19355. Phone (215) 647-3500 [Circle 428]

Self-locking cable ties molded of insulating nylon 6/6 can be installed by hand or with installation tools. Available in sizes from 4 in. to 6¾ in., they are are designed to meet or exceed commercial specifications. The ties feature a patented double-bend tapered tip.

Micro Plastics Inc., Hwy. 178N, Flippin, Ark. 72634. Phone (800) 643-2356; in Arkansas, (501) 453-2261 [Circle 431]

Signal distortion in microcircuits that must operate in humid environments is limited by dipping the circuits into silicone fluid 1107. The fluid allows soldering, and the film can be broken to allow electrical contact to the metallization, the firm says. (Mention inquiry number 3143.)

Dow Corning Corp., Midland, Mich. 48640. Phone (517) 496-4000 [Circle 429]

Cable insulations that have been cut, corroded, or abraded can be restored with Snaptube, a protective wrapping of Teflon TFE that snaps onto cables in place. Snaptube is heat resistant to 500°F and resists many chemicals.

Zeus Industrial Products Inc., P.O. Box 298, Raritan, N.J. 08869. Phone (800) 526-3842; in New Jersey, (201) 526-0800 [Circle 430]

A silver-filled two-part epoxy that cures at room temperature increases its conductivity as it cures. Among the applications of Epo-tek 415G is the repair of lifted lands on printed-circuit boards.

Epoxy Technology Inc., P.O. Box 567, Billerica, Mass. 01821. Phone (617) 667-3805 [Circle 432]

Epoxy-based inks for marking and identifying sortable wafers are cited for their purity by the manufacturer. Epocast 7800 inks have less than 10 ppm each of Na, K, NH$_4$, Fe, Cl, and Br ions. The inks are available in two colors and four viscosities.

Furane Products Co., 5121 San Fernando Rd. W., Los Angeles, Calif. 90039. Phone (818) 247-6210 [Circle 424]

COLCOAT 515
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Electrostatic
Damage

Protect delicate LSI and IC chips from electrostatic damage with COLCOAT 515, a unique, alcohol-based liquid. One application of COLCOAT 515 on a chip carrier case prevents electrostatic buildup for more than two years. It dries quickly to form a tough, protective coating.

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- What are the products, technologies, and strategies of companies such as AT&T Information Systems, InteCom Inc., Northern Telecom, United Technologies Communications Co., and others?

Issue Date:
May 6, 1985

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April 15, 1985

ElectronicsWeek
The Magazine of the
Worldwide Electronics Industry

Meetings

Hard Copy Systems of the Future, The Institute for Graphic Communications Inc. (Richard D. Murray, Director of Conferences, Institute for Graphic Communications Inc., 375 Commonwealth Ave., Boston, Mass. 02114), Holiday Inn, Monterey, Calif., March 17-19.

Industry Service Conference, The Gartner Group Inc. (72 Cummings Point Rd., Stamford, Conn. 06904), Century Plaza Hotel, Los Angeles, March 18-20.

Westec '54—Western Metal & Tool Exposition Conference, American Society for Metals and the Society of Manufacturing Engineers (SME, 1 SME Dr., Dearborn, Mich. 48121), Los Angeles Convention Center, Los Angeles, March 18-21.

Automatic Testing & Test and Measurement Conference, Network GmbH (Peter Kraus, c/o ESG Elektronik-Sys-tem-GmbH, Vogelweideplatz 9, D- 8000 München 80, West Germany), Rhein-Main-Halle, Wiesbaden, West Germany, March 19-21.

30th National Sampe Symposium & Exhibition, Society for the Advancement of Material and Process Engineering (Marge Smith, Sampe Headquarters, P.O. Box 2459, Covina, Calif. 91722), Disneyland Hotel, Anaheim, Calif., March 19-21.

Aerospace Computer Security Conference, The American Institute of Aeronautics and Astronautics (Fred Tompkins, The Mitre Corp., 1820 Dolly Madison Blvd., McLean, Va. 22102) The Mitre Corp. Conference Center, McLean, March 20.

Fourth Phoenix Conference on Computers & Communications, IEEE (Doug Powell, Motorola Inc., P.O. Box 2953, Phoenix, Ariz. 85062), Sunburst Hotel, Scottsdale, Ariz., March 20-22.

Instrumentation and Measurement Technology Conference, IEEE (Robert Meyers, 1700 Westwood Blvd., Los Angeles, Calif. 90024), Hyatt Regency Hotel, Tampa, Fla., March 20-22.

Comdex/Winter '85, The Interface Group (300 First Ave., Needham, Mass. 02194), Anaheim Convention Center, Anaheim, Calif., March 21-23.

Conference on Microscopy of Semiconducting Materials, Royal Microscopical Society/UK Institute of Physics (A.G. Cullis, Royal Signals and Radar Establishment, St. Andrews Rd., Malvern, Worcester, WR14 3PS, UK), St. Catherine's College, Oxford, UK, March 25-27.

Optical Storage of Documents & Images, Technology Opportunity Conference (TOC, P.O. Box 14817, San Francisco, Calif. 94114), Shoreham Hotel, Washington, March 25-27.

Vision '85, Society of Manufacturing Engineers (Gerri Andrews, SME Public Relations Department, 1 SME Dr., Dearborn, Mich. 48121), Cobo Hall, Detroit, March 26-28.

Seminars

Advanced Configuration Management, Technical Marketing Society of America (TMSA Seminars, c/o Technology Training Corp., ACM Department, 3420 Kashiwa St., Torrance, Calif. 90510-3608), Hyatt Orlando, Orlando, Fla., March 11-12; Resorts International, Atlantic City, March 14-15; Twin Bridges Marriott, Arlington, Va., March 18-19.

Computer Business Graphics, Frost & Sullivan Inc. (Carole Every, Frost & Sullivan Inc., 106 Fulton St., New York, N.Y. 10038), The Inn of Westchester, White Plains, N.Y., March 18-19.

CAD/CAM, Frost & Sullivan Inc. (Carole Every, Frost & Sullivan Inc., 106 Fulton St., New York, N.Y. 10038), The Inn of Westchester, White Plains, N.Y., March 20-22.

SNA—Concepts, Design & Implementation, Center for Advanced Professional Education (1820 E. Garry St., Suite 110, Santa Ana, Calif. 92705), Holiday Inn, Palo Alto, March 20-22.

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Computer Systems Equipment Design is devoted entirely to international coverage of the computer segment of the electronics industry. It is produced by a team of experienced technical editors dedicated to providing readers with the most complete and accurate technical information available. A typical issue includes detailed technical articles focusing on significant trends or techniques authored by industry experts, provides in-depth technical articles and introduces new products.

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1/3 page:	820	755	725
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Color charges:	
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Matched 2nd color:	510
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Issue and Closing Dates:

Issue Dates	Closing Dates
January 1, 1985	December 1, 1984
March 1, 1985	February 1, 1985
May 1, 1985	April 1, 1985
July 1, 1985	June 1, 1985
September 1, 1985	August 1, 1985
November 1, 1985	October 1, 1985

No Waste Circulation:

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Advertisers Index

	Amkor Electronics	3
	Anritsu Electric Co. Ltd.	12, 13
	Artificial Intelligence	91
‡	Carroll Touch Technology	7
	Colcoat Inc.	96
	Computer Optical Products	11
	Darnell	85
	Eaton Corporation	40, 41
	Elek Tek	26
	General Electric	4th C
	Hewlett Packard, San Diego	35
*	Hitachi Maxell	7E
	Honeywell Digital	8
	Ironics, Inc.	1
‡	Livingston Development Corporation	14
	McDonnell Douglas	2nd C
*	Murata	1E
	NEC Corp.	36, 37
‡	Novemet Corp.	85
	Parsec	85
	Philips T & M	44
*	Philips T & M	7
	Projects Unlimited	26
	RAC	75
*	Rohde & Schwarz	14, 4E
	SAIC	75
	Siemens Corp.	5
*	Siemens AG Munich	2E, 3E
*	Thomson Semiconductor	86, 87
	Toshiba Electronics	3rd C
*	Wild Herrbrug	8E
	Xebec Inc.	22, 23

Classified and employment advertising

Daniel D. Howard and Associates	98
Martin Marietta	97
Naval Underwater Systems	50
RCA Laboratories	98

■ For more information of complete product line see advertisement in the latest Electronics Buyers Guide
* Advertisers in International edition
‡ Advertisers in domestic edition

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PENTAGON MUST CHANGE TO GET THE BEST ICs

The question before the house this week is whether the military is being smart when it buys integrated circuits for its weapons. Or putting it another way, is the Department of Defense getting the best technology that its money—and we all know where *that* comes from—can buy?

A strong case that it isn't is made on p. 63 by the military sales manager of a Silicon Valley semiconductor firm. His thesis is that the Pentagon's purchasing practices, instituted back in the days when ICs were a onesy-twosy business, are actually a barrier between weapons systems and the best technology in a day when the IC business has become concerned with subsystems. Rather, his argument goes, the military's purchasing officers should proceed more in the manner of their counterparts in the commercial world, where vendors and users act as partners as early as the beginning of the design cycle to ensure proper fit and on-time delivery. This would give the supplier more responsibility in the procurement cycle.

The point is well taken. With advanced electronics consuming an increasingly larger portion of the defense dollar, the military must seriously consider the implications of an obsolete procurement policy. It is imperative that the armed forces be equipped with the most modern and efficient equipment that money can buy. To follow a system that prevents this is sheer folly. We realize that changing the habits of a bureaucracy like the one that buys equipment for the services is a gargantuan task, but it must be started without further delay.

THE WRONG ISSUE AT THE WRONG TIME

Remember the big flap in December about the disclosure of alleged military secrets in connection with the first all-military space-shuttle flight? It turns out that the whole thing was a tempest in a teapot.

In the Jan. 18 issue of *Science* magazine, published by the American Academy for the Advancement of Science, staff member R. Jeffrey Smith points out that Secretary of Defense Caspar Weinberger made no sense when he accused the Washington *Post* of offering "aid and comfort to the enemy" when it printed "secret" information about the flight. The reason, writes Smith, is that "nothing in the *Post*'s account, or in similar stories appearing elsewhere, offers the Soviet Union information that cannot be deduced from the . . . unclassified literature available. . . . Nor were any truly sensitive data revealed. . . . This is freely admitted in private by knowledgeable officials in the Department of Defense."

Then why did Weinberger react so strongly? Possibly, reasons Smith, because he wanted to sound a warning to discourage future reporting about military satellites.

If that's what the Pentagon wants to do, that's fine; but it certainly acted clumsily. And in so doing, it has lost some of its credibility, not to mention some of its ability to strike fear into the hearts of American journalists. As Pogo so aptly put it, "We have met the enemy, and he is us."

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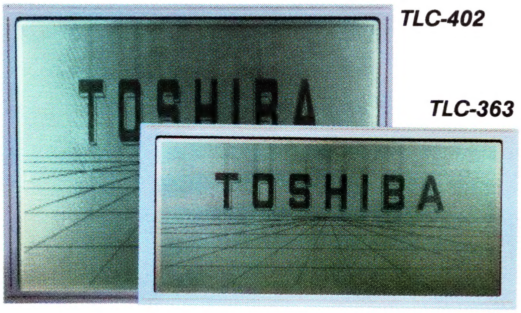

Specifications

		TLC-402	TLC-363
Display			
Number of Characters		80×25 (2,000 characters)	80×25 (2,000 characters)
Dot Format		8×8, alpha-numeric	8×8, alpha-numeric
Overall Dimensions (W×H×D)		274.8×240.6×15.0 mm	275.0×126.0×15.0 mm
Maximum Ratings			
Storage Temperature		–20 – 70°C	–20 – 70°C
Operating Temperature		0 – 50°C	0 – 50°C
Supply Voltage	V_{DD}	7 V	7 V
	$V_{DD}-V_{EE}$	18 V	18 V
Input Voltage		$0 \leq V_{IN} \leq V_{DD}$	$V_{SS} \leq V_{IN} \leq V_{DD}$
Recommended Operating Conditions			
Supply Voltage	V_{DD}	5 ±0.25 V	5 ±0.25 V
	V_{EE}	–13 V Max.	–13 V Max.
Input Voltage	High	4.0 V Min.	4.0 V Min.
	Low	0.5 V Max.	0.5 V Max.
Typical Characteristics (25°C)			
Response Time	Turn ON	300 ms	300 ms
	Turn OFF	300 ms	300 ms
Contrast Ratio		5	5
Viewing Angle		15 – 35 degrees	15 – 35 degrees

Design and specifications are subject to change without notice.

TOSHIBA

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